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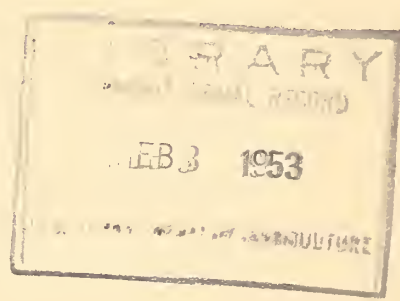


**FOREIGN AGRICULTURE REPORT**

OFFICE OF  
FOREIGN AGRICULTURAL RELATIONS  
U.S. DEPARTMENT OF AGRICULTURE  
WASHINGTON, D.C.



**CHANGES IN MEXICO'S  
CITRUS INDUSTRY**



*by*

J. HENRY BURKE  
Marketing Specialist





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UNITED STATES DEPARTMENT OF AGRICULTURE  
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## FOREWORD

This study is based on a survey of the citrus industry in Mexico made by Mr. Burke in late 1951. It deals with the changes that have taken place over a period of approximately 10 years. The Fruit Industry of Mexico, 1/ a basic report published by the Office of Foreign Agricultural Relations in 1944, contains colorful and detailed description of the country and fruit industry which is not duplicated in this study. The present study brings up to date the data on the citrus industry, and places particular emphasis on the changes that have taken place in the past decade.

Mexico's citrus industry is widely scattered and the major districts are very different one from the other. The cultural aspects of the industry are described by areas, and over-all discussion is confined to the economic factors of processing, costs, production, and trade.

This study was conducted under provisions of the Agricultural Marketing Act of 1946 as part of an evaluation of foreign citrus producing areas competing with the United States. The possibilities of broadening and maintaining foreign markets for other agricultural commodities are also being studied by this office, and the findings are presented in other circulars and reports that may be obtained, free in the United States, from the Office of Foreign Agricultural Relations, United States Department of Agriculture, Washington 25, D. C.

*Joseph A. Becker*

Joseph A. Becker, Chief  
International Commodities Branch

1/ Fred A. Motz and Lester D. Mallory, The Fruit Industry of Mexico (Foreign Agriculture Report No. 9), OFAR, U. S. Department of Agriculture, Washington, D. C., April 1944.

## ACKNOWLEDGMENT

Most of this report was prepared in the office of Mr. Kenneth Wernimont, Agricultural Attache at the American Embassy in Mexico. Mr. Wernimont's staff was helpful in obtaining and preparing material, and part of the statistical information on production and trade and trade regulations was obtained from reports prepared by Mrs. Ana M. Gomez, Assistant Agricultural Attache. This gracious assistance is deeply appreciated. The writer also wishes to acknowledge the assistance of Mr. Warren C. Stewart, American Consul at Veracruz, and Mr. J. W. Wilson and Mr. Richard A. Johnson, American Consuls at Guadalajara, and the staff of the American Consulate at Monterrey.

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# MEXICO: AREAS OF MAJOR COMMERCIAL LIME AND ORANGE PRODUCTION

**Legend:**

- International boundaries
- State or territory boundaries
- Roads (selected)
- Railroads (selected)
- Orange areas
- Lime areas
- National Capital
- Other cities, towns and villages

**INDEX TO STATES AND TERRITORIES**

Territory	Number
1. Baja California, Norte (T)	16. Guanajuato
2. Baja California, Sur (T)	17. Querétaro
3. Sonora	18. Hidalgo
4. Chihuahua	19. Colima
5. Coahuila	20. Michoacán
6. Nuevo León	21. México
7. Tamaulipas	22. Puebla
8. Sinaloa	23. Distrito Federal
9. Durango	24. Tlaxcala
10. Zacatecas	25. Guerrero
11. San Luis Potosí	26. Morelos
12. Nayarit	27. Oaxaca
13. Aguascalientes	28. Tabasco
14. Veracruz	29. Chiapas
15. Jalisco	30. Campeche
	31. Yucatán
	32. Quintana Roo (T)

- |                                  |                      |
|----------------------------------|----------------------|
| 1. Baja California,<br>Norte (T) | 16. Guanajuato       |
| 2. Baja California,<br>Sur (T)   | 17. Querétaro        |
| 3. Sonora                        | 18. Hidalgo          |
| 4. Chihuahua                     | 19. Colima           |
| 5. Coahuila                      | 20. Michoacán        |
| 6. Nuevo León                    | 21. México           |
| 7. Tamaulipas                    | 22. Puebla           |
| 8. Sinaloa                       | 23. Distrito Federal |
| 9. Durango                       | 24. Tlaxcala         |
| 10. Zacatecas                    | 25. Guerrero         |
| 1. San Luis Potosi               | 26. Morelos          |
| 2. Nayarit                       | 27. Oaxaca           |
| 3. Aguascalientes                | 28. Tabasco          |
| 4. Veracruz                      | 29. Chiapas          |
| 5. Jalisco                       | 30. Campeche         |
|                                  | 31. Yucatán          |
|                                  | 32. Quintana Roo (T) |

## SUMMARY AND CONCLUSIONS

Mexico is a rapidly changing country and the significant advances that have taken place during the past 5 years in rural education, irrigation, and highway construction will have far-reaching effects on Mexico's agricultural economy and on its citrus industry as new areas are developed and domestic markets are made more accessible.

The most notable developments in the citrus industry during the past decade have been the extension of orange plantings and the development of a processing and orange export industry.

### Planted Area

The number of orange trees has increased rapidly from the 2.5 million producing trees reported by the Mexican Government in 1939 to the 13 million total trees estimated by trade sources in 1951. This extension of orange plantings has taken place primarily in the states of Veracruz, San Luis Potosi, Tamaulipas, and Nuevo Leon. The peak of planting has been passed - Mexico had about 2 million more orange trees in 1950 than in 1951. The reduction in planted area was brought about by the destruction of groves by the citrus blackfly and by drought and frost in northeastern Mexico. Some planting is going on in Veracruz and Jalisco, but there is no new planting in northeastern Mexico where the freeze of 1951 destroyed all nursery stock.

Lime plantings have not increased so rapidly as orange plantings since 1939. The trade estimate of 2 million trees in 1951 is two and one-half times the number of producing lime trees reported officially in 1939. The centers of production have changed, and Apatzingan, Michoacan, has replaced Colima as the major producing district. Apatzingan will increase in importance as new plantings come into production.

### Production

Orange production increased as new plantings came into bearing, and in 1949 production reached 13 million boxes, over twice the 1939 production. Production dropped in 1951, however, when frost and drought in northeastern Mexico reduced the crop to 11 million boxes, over half of which was produced in Veracruz where groves were undamaged by frost. New plantings are coming into bearing, and, if groves escape damage, a crop of about 22 million boxes of oranges may be expected in 1953-54.

The production of limes increased from 850,000 boxes in 1939 to about 1.8 million boxes in 1951-52. As new plantings in Michoacan come into bearing the level of total production may be expected to increase in the future. In view of the growing production from new plantings, a crop of over 2 million boxes of limes may be expected in 1953-54.



## Orange Varieties and Fruit Quality

Descriptions of orange varieties and pictures of the fruit will be found in Part II - Studies of Major Producing States. Generally, most of Mexico's commercial orange varieties in Veracruz and Jalisco are seedlings of types unknown to the United States citrus industry. Some navels and Valencias are grown in Veracruz, but they are as yet only a small percentage of the total production. The interior quality of oranges from both Veracruz and Jalisco is excellent and resembles California fruit more than Florida fruit; the appearance of the Veracruz fruit is usually poor since it is interplanted with coffee and produced mostly without pest control.

Oranges raised in northeastern Mexico in the states of San Luis Potosi, Tamaulipas, and Nuevo Leon are mainly of Florida types, and the Parson Brown, Hamlin, Pineapple, and San Miguel form mixed plantings in the orchards and are marketed as a group called "Lisas." Valencias are also raised in these states, but they are not yet a major variety in Nuevo Leon. In these states, as in Veracruz, the fruit quality is excellent, and because of the more modern planting and cultural methods used the fruit is usually of good appearance. However, about a third of the acreage in northeastern Mexico is planted on unirrigated land where drought-breaking rains produce out-of-season blooms and fruit of uneven and uncertain maturity.

## Citrus Pests

Mexico has all the citrus pests common to the United States citrus industry, as well as a few others of special interest.

The experiments carried on during the past few years by the United States Bureau of Entomology and Plant Quarantine have developed commercial methods of controlling the citrus blackfly with oil sprays. The fact that Mexico has been able to isolate the infestation and to eradicate incipient infestations is ample evidence that this pest can be controlled. The areas devastated by the blackfly have been those where pest control was not a part of cultural practices. In the fall of 1951 there was no evidence that biological control of the blackfly had been obtained in any area of commercial citrus production in Mexico.

The most dangerous pest observed in Mexico was the Mexican fruitfly which, like the Mediterranean fruitfly, lays its eggs in mature oranges and grapefruit on the tree. In the past such pests have been important because of the loss of fruit in the orchard. Today they are far more serious because of the probable production of insect-infected juice from infected fruit. The Mexican fruitfly could be extremely dangerous to the industrialized citrus industry of the United States.

## Processing

Mexico has an old-established lime processing industry located in the processing areas of Colima and Michoacan. In the past the plants produced calcium citrate and citric acid in addition to essential oil, but in 1951 most of the juice residue from the production of essential oil was being



disposed of as waste, and only one plant in Veracruz and one in Michoacan were producing calcium citrate and citric acid. If economic conditions ever make the import of citric acid impossible, Mexico could produce the citric acid it now imports.

Essential oil of lime is likely to continue to be Mexico's primary processed lime product, and Michoacan will be the most important source of supply.

The major recent change in the processing industry is the development of orange processing in Veracruz and Nuevo Leon. Concentrating equipment is used to produce bottlers' bases primarily for Mexico's soft drink industry; some single-strength juice is also being produced.

In the future concentrated orange juice is likely to continue to be the most important product. Although there is an abundance of oranges with good processing qualities, the Mexican orange processing industry will probably be important in international trade only in non-United States markets because the presence of the Mexican fruitfly in all citrus producing areas will probably result in insect-infected fruit being present in any large-scale production of orange and grapefruit juice. This probable insect contamination is likely to prevent the large-scale import of Mexican orange and grapefruit juices into the United States.

### Outlook

All the pertinent factors of the quantity and quality of Mexico's orange production indicate the possibility of marketing difficulties in the future. If the 1953-54 season produces 22 million boxes of oranges, about 4 million boxes will probably be available for export in fresh or processed form, primarily from northeastern Mexico, and the increased production will probably result in marketing difficulties in Mexico's unorganized and indiscriminating domestic market. At production levels of nearly 1 box per capita, returns to growers are apt to be low. Early color-added, mixed-grade fruit sold from November through March will probably be exported to North American destinations only, and in the United States find a market on a price basis in the Midwest. The non-color added Valencias shipped after March will be the most competitive export fruit, and some of this variety may find a European market.

Mexico's orange processing industry is not likely to grow far beyond the present processing capacity. The presence of the Mexican fruitfly probably precludes the development of markets in the United States for Mexican orange and grapefruit juice, and the fact that Mexico is in the dollar area places Mexico in direct competition with the United States industry in all foreign markets.

Because of these economic factors it would seem unlikely that commercial orange plantings can be profitably extended much beyond the present planted area of 13 million trees.

The outlook for the production of limes is more favorable. The declining production of lemons in Italy and the resulting high prices of essential oil of lemon make it likely that Mexico will be able to find satisfactory foreign markets for its increasing production of fresh limes and essential oil of lime.

### Conclusions

There are three important facts determined by this study which will influence the future of Mexico's citrus industry. The first is the expansion of the area planted to oranges to 13 million trees making Mexico one of the world's major orange producing countries. Economic factors indicate that this planted area is about the maximum that Mexico is likely to develop in the near future. Areas suitable to citrus are available for development, but the limiting factor will be the markets that can be found for this growing production. As early as the 1953-54 crop year, surpluses of oranges are apt to occur in Mexico, because of the limited potential market for both fresh oranges and orange juices.

The second important conclusion is that Mexico does not produce export oranges of uniform quality, and this limits its opportunities to develop export markets. The lack of uniform fruit quality is the result of two factors. First, in northeastern Mexico where all the export oranges are produced, at least a third of the acreage is planted on unirrigated land where drought-breaking rains produce out-of-season blooms, causing the production of fruit of uneven and uncertain maturity. Second, and probably more important, is the practice of mixed planting and harvesting of the Lisa varieties in Nuevo Leon. A pack of mixed varieties has never proven satisfactory in the development of large-scale export markets. This lack of discipline in Mexico's citrus industry is a great commercial handicap.

The third important conclusion is that Mexico is unlikely to be able to develop a large export market for orange and grapefruit juices because the Mexican fruitfly is present in all citrus producing areas and will have a direct effect on the quality of juices produced by large-scale processing of oranges and grapefruit. Since the fruitfly lays its eggs in mature fruit, insect contamination is likely to occur and this will limit Mexico's exports of orange and grapefruit juice.

Another limiting factor is that Mexico is in the dollar area and does not have the advantages in international fruit trade enjoyed in recent years by the Mediterranean citrus producing countries which have a soft currency.

Mexico's young orange industry does not seem likely to overcome these difficulties in the near future, and therefore we may expect Mexico's participation in international trade in citrus and citrus products to be limited.



ACREAGE AND PRODUCTION

The citrus industry in Mexico is very extensive, and official data indicate that oranges are produced commercially in 31 states and limes in 22 states. The extent of the industry and the more important areas of production can be seen from the data in tables 1 and 2 on number of trees and production. Although the data in these tables indicate the growth that has taken place in the Mexican citrus industry since 1939, they are presented primarily to indicate the extent and comparative importance of the producing areas.

About one-third of this widespread industry is not commercial because the fruit is consumed in or near the area of production. Four states produce the majority of the commercial supplies of oranges for the metropolitan centers, such as Mexico City, and also the export fruit, and three states provide the majority of limes for processing and for export.

Oranges

Detailed information on the extent of the orange industry and on economic conditions in the more important producing states, is presented in Part II - Studies of Major Producing States.

In table 3 the estimated planted area for 1939 and 1949 is compared with estimates made from data obtained from trade sources in the field in 1951. The 1951 estimate of nearly 13 million orange trees in Mexico may be considered as a conservative figure, for both San Luis Potosi and Tamaulipas undoubtedly have more planted trees than is indicated. There may actually be 1 million more orange trees than indicated in these two states. The 4.7 million trees indicated for Nuevo Leon is also a conservative estimate and should be considered as an evaluation of commercial plantings; total plantings of orange trees in Nuevo Leon are probably near 7 million trees. The number of orange trees indicated in table 3 for Tamaulipas, San Luis Potosi, and Nuevo Leon are corroborated by the tree taxes collected to combat the blackfly. The tree count data available for Veracruz is not as complete, and the indicated 5 million orange trees is an estimate by the Veracruz State Department of Agriculture. Observations in the field indicate that there are many more trees than the 1 million producing trees reported in the official statistics for 1949. If we consider that the State estimate of 5 million trees is approximately correct--as it would seem to be--and that about 20 percent of the planted area is not commercial, then there are at least 4 million commercial orange trees in Veracruz. Observations in the field substantiate such a planted area.

Table 1.--Mexico: Number of orange trees, acreage, and production, by states, 1939 and 1949

State	Number or producing:		Acreage		Production 1/	
	trees					
	1939	1949	1939 2/	1949 3/	1939	1949
	Thousands	Thousands	Acres	Acres	Boxes	Boxes
Coahuila . . . . .	4/	2:	10:	35:	1,669:	3,968
Chihuahua . . . . .	11:	19:	173:	306:	30,864:	52,186
Durango . . . . .	60:	60:	944:	983:	152,306:	158,070
Nuevo Leon . . . . .	420:	1,882:	6,565:	31,018:	784,586:	5,165,063
San Luis Potosi . . . . .	271:	369:	4,233:	6,086:	639,681:	1,021,895
Tamaulipas . . . . .	71:	203:	1,112:	3,346:	161,723:	490,177
Zacatecas . . . . .	25:	27:	386:	450:	54,233:	58,044
Campeche . . . . .	38:	54:	598:	892:	112,781:	144,968
Quintana Roo . . . . .	7:	9:	101:	141:	17,007:	21,574
Tabasco . . . . .	49:	72:	761:	1,181:	168,242:	190,037
Veracruz . . . . .	732:	1,073:	11,448:	17,673:	1,419,668:	2,433,123
Yucatan . . . . .	114:	149:	1,779:	2,446:	267,512:	349,398
Baja California . . . . .	7:	13:	106:	222:	13,133:	30,046
Nayarit . . . . .	8:	20:	131:	333:	16,283:	38,140
Sinaloa . . . . .	18:	33:	279:	539:	38,770:	81,759
Sonora . . . . .	51:	76:	803:	1,253:	134,260:	201,406
Colima . . . . .	6:	8:	94:	138:	26,991:	22,235
Chiapas . . . . .	64:	92:	1,001:	1,510:	172,022:	243,923
Guerrero . . . . .	18:	29:	284:	477:	41,352:	62,642
Oaxaca . . . . .	56:	82:	877:	1,347:	116,434:	196,083
Aguascalientes . . . . .	13:	20:	195:	326:	4,787:	55,367
Distrito Federal . . . . .	4/	1:	8:	15:	1,606:	2,205
Guanajuato . . . . .	12:	22:	180:	356:	25,070:	55,902
Hidalgo . . . . .	91:	133:	1,433:	2,192:	260,269:	344,295
Jalisco . . . . .	285:	333:	4,453:	5,486:	501,673:	784,680
Mexico . . . . .	15:	21:	227:	353:	27,715:	44,218
Michoacan . . . . .	63:	106:	991:	1,747:	152,212:	208,839
Morelos . . . . .	26:	34:	400:	563:	72,909:	76,405
Puebla . . . . .	136:	172:	2,130:	2,827:	303,605:	380,042
Queretaro . . . . .	14:	19:	215:	309:	32,628:	31,872
Tlaxcala . . . . .	4/	1:	8:	15:	1,260:	1,764
Total . . . . .	2,681:	5,134:	41,925:	84,565:	5,753,251:	12,950,326

- 1/ Converted from metric tons to boxes of 70 pounds.  
2/ Computed at 158 trees per hectare (64 trees per acre).  
3/ Computed at 150 trees per hectare (61 trees per acre).  
4/ Less than 500.

Source: Boletín Mensual de la Dirección de Economía Rural, Secretaría de Agricultura y Ganadería.



Table 2.--Mexico: Number of lime trees, acreage, and production, by states, 1939 and 1949

State	Number of producing:		Acreage		Production 1/	
	trees					
	1939	1949	1939	1949	1939	1949
	Thousands	Thousands	Acres	Acres	Boxes	Boxes
Chihuahua . . . .	1:	2:	25:	30:	1,405:	2,149
Durango . . . .	4:	5:	67:	84:	4,464:	4,767
Nuevo Leon . . . .	7:	6:	116:	101:	9,590:	4,933
San Luis Potosi . . . .	37:	89:	588:	1,468:	31,664:	80,027
Tamaulipas . . . .	13:	137:	202:	2,251:	10,747:	174,990
Zacatecas . . . .	2:	3:	30:	44:	1,378:	2,673
Campeche . . . .	5:	8:	81:	133:	5,456:	8,984
Quintana Roo . . . .	2:	4:	25:	64:	909:	3,693
Tabasco . . . .	26:	35:	405:	576:	28,054:	44,147
Veracruz . . . .	125:	170:	1,950:	2,800:	98,436:	199,103
Yucatan . . . .	33:	42:	514:	684:	38,498:	41,254
Baja California <sup>2/</sup> TN:	2/	2/	5:	7:	579:	606
Baja California <sup>2/</sup> TS:	2:	1:	7:	15:	661:	1,268
Nayarit . . . .	5:	16:	87:	268:	7,248:	20,117
Sinaloa . . . .	28:	23:	440:	371:	29,817:	30,920
Sonora . . . .	3:	5:	49:	86:	3,224:	6,448
Colima . . . .	154:	355:	2,414:	5,841:	176,285:	397,104
Chiapas . . . .	44:	53:	684:	880:	50,182:	65,394
Guerrero . . . .	35:	42:	541:	699:	37,230:	51,119
Oaxaca . . . .	33:	53:	509:	870:	31,471:	66,331
Aguascalientes . . . .	1:	3:	10:	47:	606:	3,197
Distrito Federal . . . .	1:	1:	7:	15:	413:	799
Guanajuato . . . .	7:	11:	116:	178:	9,700:	13,228
Hidalgo . . . .	17:	44:	270:	719:	13,172:	59,910
Jalisco . . . .	43:	70:	680:	1,149:	49,659:	101,108
Mexico . . . .	10:	11:	153:	188:	12,787:	12,180
Michoacan . . . .	126:	302:	1,974:	4,979:	155,067:	346,095
Morelos . . . .	13:	17:	200:	282:	22,129:	18,105
Puebla . . . .	22:	23:	339:	385:	17,995:	26,317
Queretaro . . . .	4:	5:	62:	82:	3,693:	4,519
Tlaxcala . . . .	2/	1:	5:	20:	220:	965
Total . . . .	803:	1,537:	12,555:	25,315:	852,739:	1,792,450

1/ Converted from metric tons to boxes of 80 pounds.

2/ Less than 500.

Source: Boletín Mensual de la Dirección de Economía Rural, Ministry of Agriculture

Table 3.--Mexico: Estimated number of orange trees and planted area, by producing areas, 1939, 1949, and 1951

District	1939		1949		1951 (est.) <sup>1/</sup>	
	No. of pro- : ducing trees:	Planted : : area	No. of pro- : ducing trees:	Planted : : area	Number of : : trees	Planted : : area
		Acres		Acres		Acres
Nuevo Leon . .	420,000	6,565	1,882,000	31,018	2/ 4,782,610	77,138
San Luis Potosi:	271,000	4,233	369,000	6,086	760,168	12,521
Tamaulipas . .	71,000	1,112	203,000	3,346	673,960	11,102
Veracruz . . .	732,000	11,448	1,073,000	17,673	5,000,000	26,462
Total, above :						
four States 3/:	1,494,000	23,358	3,527,000	58,123	11,216,738	127,223
Balance of :						
Mexico . . . :	1,187,000	18,567	1,607,000	26,442	3/ 1,607,000	26,442
Total, :						
Mexico . . . :	2,681,000	41,925	5,134,000	84,565	12,823,738	153,665

1/ Trade and personal estimates based on sources as indicated in data on individual States.

2/ Estimate of number of trees in commercial condition.

3/ A personal estimate; new plantings have probably about equaled tree removal because of the blackfly.

Source: 1939 and 1949, Boletín Mensual de la Dirección de Economía Rural, Secretaría de Agricultura y Ganadería.

A comparison of the trade estimates for 1951 with the official data for 1939 indicates that the number of trees in Nuevo Leon has increased tenfold, while those in San Luis Potosi have about doubled. Tamaulipas has grown more rapidly than San Luis Potosi and in 1951 had nearly 10 times as many trees as in 1939. In Veracruz the present number of trees is probably about 5 times the number in 1939. In the other orange producing states of Mexico no change is indicated in the number of trees and only slight growth is indicated from 1939 to 1951.

In 1950 there were probably about 15 million orange trees in all of Mexico, but the destruction of trees by the blackfly, together with drought and frost in northeastern Mexico, reduced the planted area by about 2 million trees. The greatest effort in extending orange plantings has been passed. In 1951 some new planting was being done in Veracruz, Jalisco, and San Luis Potosi; however, there was no replanting of destroyed orchards in Nuevo Leon or Tamaulipas.

In table 4 the official production figures for 1939 and 1949 are compared with trade estimates for 1951 and 1952. The extensive frost damage in northeastern Mexico which reduced the crops of Nuevo Leon, San Luis Potosi, and Tamaulipas made the 1951-52 crop year an unusual one, and about two-thirds of the orange production came from the State of Veracruz, which was undamaged by frost.

It will be noted that the estimates for 1951-52 give Veracruz over 6 million boxes, nearly three times the production indicated in 1949. This is not to be considered as an increase but rather that the 1949 official estimate has been understated.

Outlook for orange production and exports. The production of oranges in Mexico should increase rapidly in the next few years. From observations in the field, given in detail in the studies by states, an estimate has been prepared of the probable production of the 1953-54 crop year, assuming that no climatic disasters further injure the producing areas (table 4). Both San Luis Potosi and Tamaulipas will recover production but will be of far less importance than Nuevo Leon or Veracruz. Nuevo Leon should have recovered from the frost damage by 1953-54, but production in this area will probably be retarded since the considerable acreage planted on unirrigated land will have low yields. As new orchards come into bearing in Nuevo Leon the production of oranges may increase to nearly 9,500,000 boxes in the next 5 years. This will depend somewhat upon the rapidity of recovery from frost damage and the development of new irrigation projects in northeastern Mexico. There is far more hazard from frost and drought in northeastern Mexico than in Veracruz. In Veracruz, the undamaged orchards will probably have a total production about equal to that of Nuevo Leon in 1953-54.



Table 4.---Mexico: Estimated production of oranges by producing area, 1939, 1949, and 1951-52, and estimated production and export potential, 1953-54

District	1939		1949		1951-52 (est.)		1953-54 (est.)	
	Production	Boxes	Production	Boxes	Production	Boxes	Production	Boxes
Nuevo Leon . . . . .	784,586	:	5,165,064	:	692,874	3/	7,873,572	:
San Luis Potosi . . . . .	639,681	:	1,021,895	:	314,943	:	1,259,772	:
Tamaulipas . . . . .	161,723	:	490,177	:	314,943	:	1,574,715	:
Veracruz . . . . .	1,419,668	:	2,433,123	:	6,298,858	3/	7,873,572	:
Total, above four states . . . . .	3,005,658	:	9,110,259	:	7,621,618	:	18,581,631	:
Balance of Mexico . . . . .	2,747,593	:	3,840,067	4/	3,840,067	4/	3,621,843	:
Total, Mexico . . . . .	5,753,251	:	12,950,326	:	11,461,685	:	22,203,474	:

1/ Trade and personal estimates. See data on individual States for sources.

2/ Personal estimates based on outlook.

3/ Production in Nuevo Leon will be retarded because of the low yield of unirrigated groves and of young groves just coming into production. Veracruz will probably produce as much as Nuevo Leon; however, most Veracruz fruit is not of export types.

4/ A personal estimate from observed areas of production.

Source: 1939 and 1949, Boletín Mensual de la Dirección de Economía Rural, Secretaría de Agricultura y Ganadería.



Table 4 also shows an estimate of potential quantity of fruit available for export in 1953-54. All of the oranges from San Luis Potosi will be consumed domestically; the Rio Verde district produces export quality fruit, but it is not accessible to export markets. In Tamaulipas fresh export fruit will be produced primarily in the vicinity of Carmen. Nuevo Leon will continue to be a major source of supply of fresh oranges for export because of its proximity to the border and probable production levels indicate an export potential of over 3 million boxes by 1953-54. While some concentrated orange juice may be exported from Nuevo Leon, the bulk of exports will probably be as fresh fruits. A potential export of 315,000 boxes is indicated for Veracruz but all of this will be in the form of orange juice concentrate and single-strength juice. No fresh orange exports are likely to be made from Veracruz owing to the difficulty of transportation and to the poor exterior grade of fruit which results from the interplanting of oranges with coffee.

### Limes

The data on the planted area of limes compiled in the studies of individual citrus producing states have been summarized in table 5. Since 1939, the planting of limes has increased--but not so rapidly as the planting of oranges--and the areas of production have changed. Colima is no longer the major source of production because of the removal of orchards for economic reasons and the infestation of the blackfly.

Veracruz plantings have decreased to some extent; however, some new plantings have been made recently. The major increase in the plantings of limes has occurred in Michoacan near Apatzingan where present planted acreage is nearly 7 times that of 1939. Since plantings are continuing in Michoacan, the planted area will probably continue to increase for some years in spite of the fact that the seedling lime trees have a rather short life and some must be replaced every 10 to 15 years. In 1951 Mexico had an estimated 2 million lime trees, approximately two and one-half times as many as the producing trees reported in 1939.

Table 6 compares the official production figures for 1939 and 1949 with trade estimates for 1951-52. The crop year 1951-52 was unusual owing to the fact that frost destroyed the crop near Llera, Tamaulipas, greatly reducing the season's production in that area.

Colima is now producing only slightly more limes than in 1939 owing to the removal of groves and the infestation of the blackfly. Veracruz has also increased only slightly, with some newly planted groves replacing old abandoned groves. The major change in the production of limes in Mexico has occurred in Michoacan where the 1951-52 crop of over 800,000 boxes was over 5 times that of 1939.

Table 5. Mexico: Estimated number of lime trees and planted area, by producing areas, 1939, 1949, and 1951

District	1939			1949			1951 1/		
	No. of pro- ducing trees	Planted area	Acres	No. of pro- ducing trees	Planted area	Acres	Number of trees	Planted area	Acres
Colima . . . . .	155,000	2,414		356,000	5,841		300,000	2,471	
Apatzingan, Michoacan	126,000	1,974		303,000	4,979		900,000	14,826	
Veracruz . . . . .	125,000	1,950		170,000	2,800		150,000	2,449	
Tamaulipas . . . . .	13,000	203		137,000	2,251		150,000	2,471	
Total, above four States . . . . .	419,000	6,541		966,000	15,871		1,500,000	22,217	
Balance of Mexico . .	384,000	6,014		571,000	9,444	2/	500,000	2/8,208	
Total, Mexico . . .	803,000	12,555		1,537,000	25,315		2,000,000	30,425	

1/ Trade and personal estimates based on sources as indicated in data on individual states.  
 2/ This reduction is primarily due to the removal of trees in the Valles district of San Luis Potosi.

Source: 1939 and 1949, Boletin Mensual de la Direccion de Economia Rural, Secretaria de Agricultura y Ganaderia.

Table 6.—Mexico: Estimated production of limes by producing area 1939, 1949, and 1951, and estimated production and export potential, 1953-54

District	1939		1949		1951-52 (est.) 1/		1953-54 (est.) 2/	
	Production	Boxes	Production	Boxes	Production	Boxes	Production	Export potential
Colima . . . . .	176,285		397,103		275,575		275,575	3/ 137,788
Apatzingan, Michoacan:	155,066		346,095		826,725		964,512	3/ 551,150
Veracruz . . . . .	98,435		199,103		137,787		165,345	3/ 27,557
Tamaulipas . . . . .	10,748		174,990		13,779		137,788	4/ 13,779
Total, above four states . . . . .	440,534		1,117,291		1,253,866		1,543,220	730,274
Balance of Mexico . . . . .	412,205		675,159	5/	620,044		620,044	4/ 27,557
Total, Mexico . . . . .	852,739		1,792,450		1,873,910		2,163,264	757,831

1/ Trade and personal estimates, see source data in individual state studies.

2/ Personal estimates based on outlook.

3/ In normal years exports will be about two-thirds as essential oil and one-third as fresh fruit.

4/ Primarily as fresh fruit.

5/ Reduction primarily due to the elimination of Valles, San Luis Potosi, as a producing area.

Source: 1939 and 1949, Poletin Mensual de la Direccion de Economia Rural, Secretaria de Agricultura y Ganaderia.



Outlook for lime production and exports. Some new planting is taking place in Colima, but it is likely that the continued removal of old orchards will prevent production from increasing above present levels. Tamaulipas should recover production to about 1949 levels or slightly more, and Veracruz will about maintain production at present levels as new producing acreage replaces old orchards. Apatzingan, however, will have increased production; a crop of 964,000 boxes is possible in 1953-54; and production may reach 1.3 million boxes within the next 5 years if the present trend of plantings is maintained. Thus the supplies of limes in Mexico may be expected to increase. An estimate of the production and export potential for the 1953-54 season is given in table 6.

About two-thirds of the potential exports estimated in 1953-54 will be as fresh fruit and the balance essential oil of lime.

Mexico now imports most of its citric acid; however, the juice residue now disposed of as waste could supply most of Mexico's requirements of citric acid if economic conditions made it feasible to produce calcium citrate.

## PROCESSING

Mexico's orange processing industry has been created during the past 10 years. The processing of limes has been carried on in Mexico for many years, primarily in Colima and Michoacan, but orange processing is essentially a development of the past 10 years.

In the past, essential oil of lime, calcium citrate, and citric acid were the primary products. After World War II, the production of calcium citrate and citric acid was practically discontinued, and lime processing was confined to the production of essential oil. In 1951, the production of calcium citrate and citric acid was resumed. Calcium citrate was being manufactured in Veracruz and in Michoacan at Apatzingan, and citric acid at one plant near Coatepec, Veracruz, and at a new installation at Apatzingan, Michoacan. Mexico could produce all the citric acid it requires if the juice residue from the production of essential oil were utilized for the production of calcium citrate, but producers state that the production cost is higher than the price of the imported product. However, if a shortage of foreign exchange should interfere with citric acid imports, the production of calcium citrate and citric acid would certainly increase in both Michoacan and Colima. Some single-strength lime juice has been produced, but this has not proved to be a very popular product.

Orange processing, which is carried on in Veracruz and Nuevo Leon, is confined primarily to bottlers' bases. Some single-strength juice is being produced, principally for the domestic market.

### Processing Plants

In 1951 oranges were being processed in Veracruz and Nuevo Leon, and limes in Veracruz, Michoacan, and Colima. The orange and lime processing plant at Llera, Tamaulipas, was not in operation in the latter part of 1951.

Colima. Four or five lime processing plants are operating in the State of Colima. The largest plant at Colima now uses about 71,650 boxes of limes per year, but in average years processes only about 41,336 boxes. At present the only products produced are essential oil of lime and fresh and sun-dried lime peel. In the process used the fruit is ground, and essential oil is prepared by two methods. To produce distilled oil, the juice and oil liquor is put in large wooden tanks where it is heated by steam pipes to evaporate the essential oil. Cold-pressed oil is produced by separating the oil from the juice by centrifuge instead of distillation. The cold-press method produces a better quality oil but 1 pound less oil per metric ton of fruit than does the distillation method. Processors report that they recover about 8 pounds of essential oil per metric ton of limes by the distillation method. The largest plant at Colima has facilities for making calcium citrate and citric acid, but this part of the plant is not in use. Trade sources also report that attempts to export calcium citrate have been unsuccessful because of the high Mexican export tax. The peel residue of this plant is sold in fresh or sun-dried form for use as cattle feed.



In addition to a large plant there are two or three smaller plants near Colima and one at Tecoman producing essential oil by the process described above. In the processing plants at Colima the juice residue was disposed of as waste in 1951. All of the plants are fairly simple operations, and most of them have auxiliary electric generating capacity for use when the local power fails.

Processors at Colima were paying \$47.24 per ton for limes at the plant in the fall of 1951. The recent average price is reported to be \$36.74 per ton. In 1948, processors were paying only \$8.40 per ton for processing limes.

In 1950, according to trade sources, Colima produced 33,069 pounds of essential oil of lime, which was sold at an average price of \$4.72 per pound.<sup>1/</sup> Trade sources also estimate that about 60 percent of the limes produced in the State in 1950 were processed.

Michoacan. 2/ Essential oil of lime, dehydrated lime peel, and citric acid are produced at Apatzingan, which is the largest lime processing center in Mexico. Essential oil is produced in two plants in Apatzingan and two or three small installations in the vicinity. Processing is an important outlet for fruit, and trade sources estimate that in normal years at least 50 percent of the total production is processed. This may amount to as much as 413,000 boxes per year. A large modern processing plant, which was built with government aid and started operation in 1950, sometimes processes as much as 50,000 boxes per month. In the period from June to December 1951 this plant used 276,000 boxes of limes for processing purposes and packed 56,000 boxes of fresh limes for the domestic market and 17,500 boxes for export.

This plant is capable of producing distilled and cold-press essential oil, dehydrated lime peel, and single-strength canned juice on a large scale, but it is doubtful if its full capacity will ever be used. Unsold stocks of canned single-strength lime juice in cans of approximately 4 ounces indicate the difficulty of marketing this product. A more ready market has been found for single-strength juice, packed in barrels and preserved with sulfur dioxide. This product, which is packed on order for the use of soft drink bottlers, could be produced with much more simple equipment than that installed. In the fall of 1951 the canning equipment was idle, as was the juice extracting equipment.

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<sup>1/</sup> Obtained from the American Consulate, Guadalajara, Jalisco, from data prepared by Mr. J. W. Wilson, American Consul.

<sup>2/</sup> Production data and prices of processed products were obtained through the kindness of Ing. Archibaldo Aranda, Nacional Financiera, S. A., Planta Industrializadora de Vegetales, Apatzingan, Michoacan.



Left. Colima's largest lime processing plant. The tank is used to produce lime oil by the distillation process.



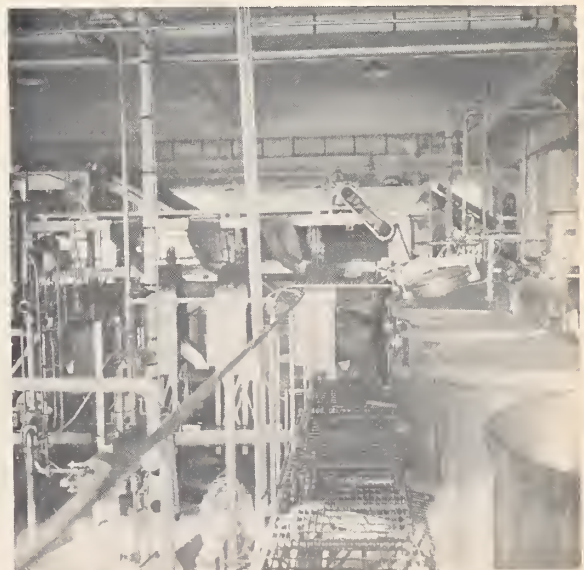
Lime peel dehydrator at Apatzingan. Dehydrator is at left and storage bin and sacks of dried peel at right.



Apatzingan's largest lime processing plant. The can-closing machinery was not being used in the fall of 1951.



Stills for separating essential oil from lime juice, Apatzingan.



Lime processing plant at Apatzingan. Juice extractors are at rear, and stainless steel storage and mixing tanks for juice products at right.





A citric acid and essential oil of lime plant at Apatzingan.



Tanks for processing lime juice into calcium citrate, Apatzingan.



Left. A filter press used to recover calcium citrate, Apatzingan. Right. Cakes of calcium citrate after removal from the filter press. The calcium citrate is treated with sulfuric acid to produce citric acid.



The primary products of the plant are essential oil, produced by the distillation process, and dehydrated lime peel. The dehydrator is modern and apparently of much larger capacity than the plant will need since the processing of limes does not produce a large quantity of peel. In the 6-month period from June to December 31, 1951, the plant produced 209 short tons of dehydrated peel, which was sold at an average price of \$21 per short ton.

This large plant is useful to the area as a marketing outlet for fruit that is not suitable for export, but it seems to be overequipped for the type of processing being carried on.

In October 1951, a smaller plant began utilizing waste juice residue for the production of calcium citrate and citric acid. This plant has fruit grinders and essential oil stills and could produce its own juice if necessary, but in the fall of 1951 it was purchasing waste juice from the larger plant at the equivalent of \$1.31 per 100 gallons. The juice is mixed with lime to produce calcium citrate which is separated out with a filter press. The calcium citrate thus produced is treated with sulfuric acid to produce citric acid, which is purified through three distillations. This is the only plant at either Apatzingan or Colima producing calcium citrate or citric acid; all the others dispose of the juice residue as waste.

In 1951 the average price paid for limes of processing quality was \$39.89 per short ton and the average price paid for export quality limes was \$73.48 per short ton. The value of limes as fresh fruit is thus about twice the value of processing quality yellow limes.

Trade sources report that in 1951 essential oil of lime was being sold for \$6.00 to \$7.00 per pound f.o.b. Apatzingan and that single-strength lime juice brought \$0.40 per gallon f.o.b. Apatzingan.

Tamaulipas. A large, well-equipped orange and lime processing plant was built in 1949 near Llera with the aid of government financing. The equipment installed includes a large steam plant, an electric generating plant, modern fresh-fruit packing equipment, one modern citrus juice extractor, stainless steel storage and mixing tanks, canning equipment, a peel dehydrator of large capacity, and a modern citrus juice concentrator capable of producing 65° Brix concentrate. The plant has a processing capacity of at least 100 tons of fruit per day.

There is a small citrus area near Llera which produces mostly limes, but citrus production in the area is far below the capacity of the processing plant. All other sources of fruit are at least 50 miles from the plant. Valles, San Luis Potosi, is the nearest southern district, Carmen, Tamaulipas, the nearest northern district, and the major area of citrus production at Montemorelos, Nuevo Leon, is approximately 100 miles away.

The plant was not operating in late 1951 and will probably not be operated in the 1951-52 season, since the local producing area was seriously damaged by frost in February 1951. This plant has been operated for only short periods of time since its construction. The 65° Brix orange juice concentrate produced has been sold to soft drink bottlers in Monterrey.

Veracruz. In the past 10 years citrus processing in Veracruz has developed from practically nothing into a substantial industry.

A lime processing plant established on a large grove near Veracruz produces calcium citrate, essential oil of lime, and sun-dried lime peel. The capacity of the plant may be judged by the fact that about 40 tons of calcium citrate are produced each year. On this property limes are packed for export, and all the nonexport quality limes are processed by grinding the fruit in machines that extract all the oil and juice and separate out the lime peel which is sun dried for cattle feed. The juice and oil liquor is carried to large wooden vats where it is heated by steam pipes installed in the vats. The oil is evaporated off, distilled, and separated from the juice residue by filtering. The remaining juice is placed in large vats and made into calcium citrate. This plant has also produced lemon-grass citral. Samples were still available at the plant, but the operators stated that this product was no longer being produced.

The most important development in citrus processing in the State of Veracruz has taken place in the past 6 years near Coatepec where the Mission Orange Company of Mexico has established a modern citrus processing plant on the Finca La Orduna with a capacity of 5,000 to 7,000 tons of fruit per year. This plant was originally developed primarily to produce citrus base products for the manufacture of soft drinks in Mexico. These base products are sold largely through bottlers in Mexico who hold a franchise to bottle Mission orange drinks. The plant has two mechanical juice extractors and a concentrator which can also produce 65° Brix concentrates. Last year the plant experimented successfully with the production of small quantities of single-strength canned juices, and it is now in the process of installing equipment for canning single-strength juices in No. 1 and No. 2 cans. In addition, the company plans to pack 6-ounce cans of a 3-to-1 hot-pack citrus juice concentrate which will be much like the frozen orange juice concentrate in that it will consist of concentrated juice mixed with a cutback of raw juice in order to produce a product with natural juice flavor. These new products are to be sold in Mexico.

The oranges used for processing are primarily the seeded Corriente, which is grown in coffee plantations, and another seeded orange known locally as a "Jaffa." This local "Jaffa" does not seem to be related to the Shamouti.

The company recently installed an Italian machine that will extract the essential oils from the peel of limes before the juice is extracted from the fruit, and it now plans to install a peel dehydrator to produce dried citrus peel for cattle feed.

In the past this company has purchased citric acid for use in preparing citrus bases. However, tanks are now being installed in which calcium citrate will be manufactured into citric acid at the plant.

This plant is a well-conceived processing unit and produces its own electric power from a small hydraulic plant and from two auxiliary Diesel engines. The plant also has adequate steam supplies from a 300 hp. boiler.





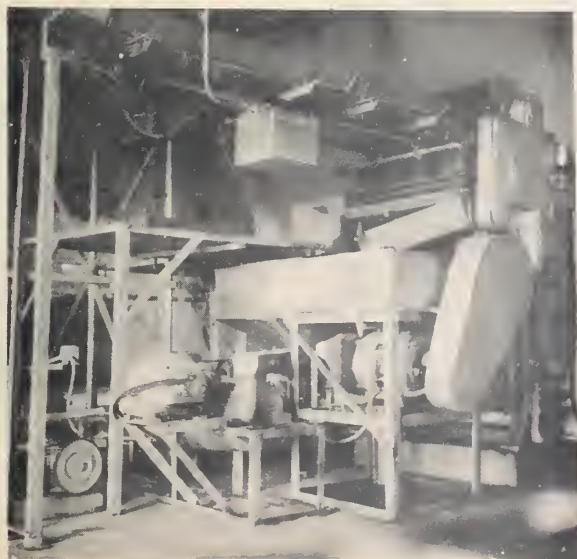
A large lime and orange processing plant at Llera, Tamaulipas.



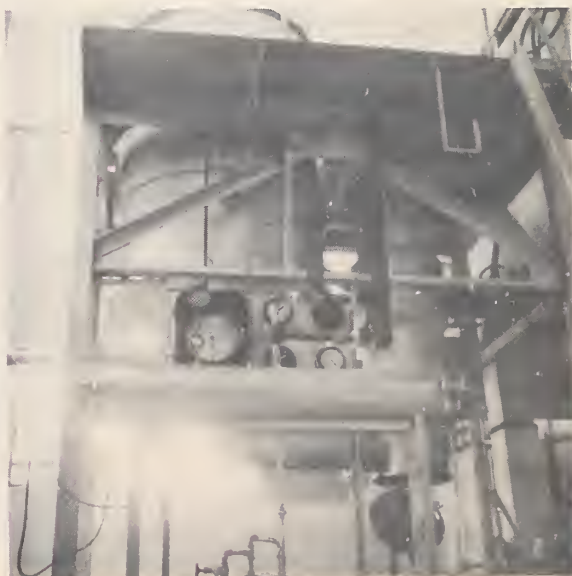
A peel dehydrator at Llera.



Citrus juice processing equipment (left), and citrus juice canning equipment (above) at Llera.



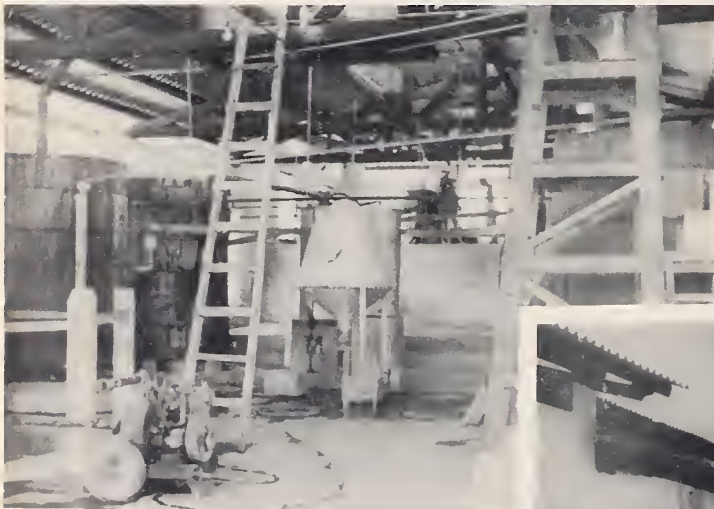
Orange juice extractor at Llera.



Citrus juice concentrator at Llera.



Machines for grinding limes to extract the essential oil and juice (near Veracruz).



Left. Wooden vats for holding lime juice and evaporating out the essential oil. The vats on the left are for making calcium citrate from lime juice (near Veracruz).

Right. Lime processing plant and floor for sun-drying lime peel for cattle feed (near Veracruz).





The orange juice concentrate manufactured for the citrus bases is packed in barrels and kept under refrigeration until it is needed for the mixing of bases which are packed in smaller containers for the beverage manufacturer. A part of the cold-storage facilities maintain a temperature of 0° F.

This plant has offered a new outlet for citrus in this area. Fruit is purchased from growers on a weight basis at the plant--an arrangement that pleases many suppliers since they avoid the nebulous contracts that are often made with fresh fruit buyers.

Some concentrated orange juice has been sold to Canada and attempts have been made to sell juice in Europe, but processors state that they cannot compete with the prices at which United States processors are able to sell under the export payment program of the Department of Agriculture.

Nuevo Leon. The only citrus processing plant in Nuevo Leon is the Nesbitt de Mexico plant near Monterrey. This plant was constructed primarily for the production of bottlers' bases and has been in operation for about 2 years. It is a small plant, utilizing only about 35 tons of fruit per day, but it is well-equipped and capable of turning out a high-quality product. The equipment includes a scale for weighing truckloads of fruit as they are received and a receiving bin from which fruit is carried by mechanical conveyers to an automatic juice extracting machine. The processing equipment includes a concentrator which produces 68° Brix orange juice concentrate under vacuum, and also a flash pasteurizer and can filling and closing equipment for the production of single-strength citrus juice. Until the fall of 1951 only concentrates were produced; however, in December 1951 it was planned to begin canning single-strength orange juice to be packed in No. 2, No. 2-1/2, and No. 10 cans. All the single-strength juice will be sold in Mexico.

Most of the orange juice concentrate is sold to bottlers in Mexico; it is packed in barrels and kept under refrigeration until it is needed for the mixing of bottlers' bases during the year. A small percentage of benzoate of soda is added to the juice as a preservative. In 1950, the company exported about 600 tons of 68° Brix orange juice concentrate to Canada. This product was also packed in barrels.

Owing to the shortage of fruit in 1951-52 it was expected that the processing season would be short and that processing fruit would cost \$26.24 per short ton at the plant.

According to trade sources, a vegetable and meat packing plant in Monterrey is considering the possibility of installing facilities for processing citrus juices. However, due to the small supplies of fruit which will be available during the 1951-52 season it is unlikely that any decision will be made at this time.

Supplies for processing purposes will probably be abundant in Nuevo Leon in normal years, since large quantities of oranges are produced near Monterrey. The fruit utilized in processing is primarily early varieties which are sold under the term "Lisa" and include Hamlins, Parson Brown, Pineapple, and

San Miguel. These fruits are available in quantity from November to February. Considerable quantities of Valencia oranges are also raised in the area, but these usually sell at higher prices because of the scarcity of oranges in Mexico in May and June and are too costly for utilization as processing fruit.

### Marketing of Processed Citrus

Marketing is one of the biggest problems of Mexican processors. The limited nature of the domestic market presents a problem in operating plants at capacity during the orange processing season, which in normal years is only 4 to 5 months, mainly November to February; and the presence of the Mexican fruitfly will probably preclude any large-scale exports of juice products to the United States.

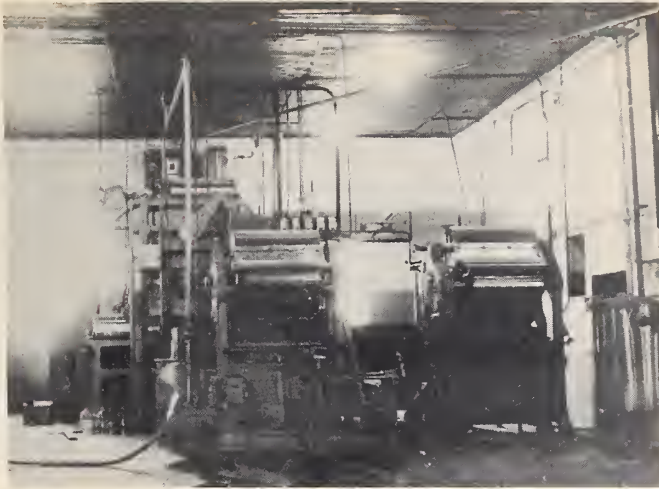
Mexico is in a favorable position for processing citrus fruit as regards supplies of fruits, and the price of containers compares favorably with the prices European processors pay. In entering the European market, however, Mexico is at a disadvantage in that it is in the dollar area and must compete directly with the highly industrialized United States citrus industry. Processors report that the export subsidy on United States processed citrus products has been the major obstacle to the development of European markets for Mexican juice.

Most of Mexico's processed lime products are exported, but processed orange products are consumed largely on the domestic market.

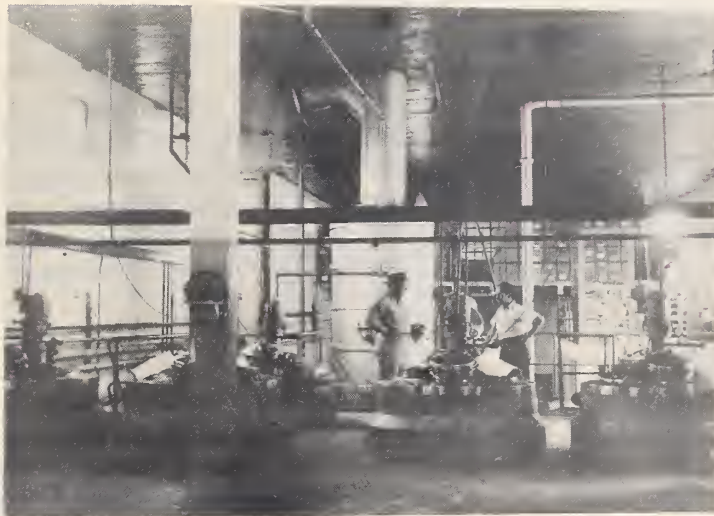
Essential oils. Mexico is a primary supplier of essential oil of lime and finds a ready market in the United States for this product (see table 7). Exports of essential oil of lime have been increasing, and in 1950 exports reached 197,825 pounds, which is over 12 times the 1940 figure and about 1-1/2 times the peak wartime exports. Essential oil of lime has been and will continue to be the major citrus processed product exported to the United States. The growing production of limes in Michoacan indicates that lime oil exports may increase in the future.

Orange oil has been a minor export item except during the war years 1941-43 when exports averaged over 3,000 pounds per year (table 7). Only 212 pounds were exported in 1950. Much larger quantities of orange oil could be produced and exported if the world price made sales profitable.

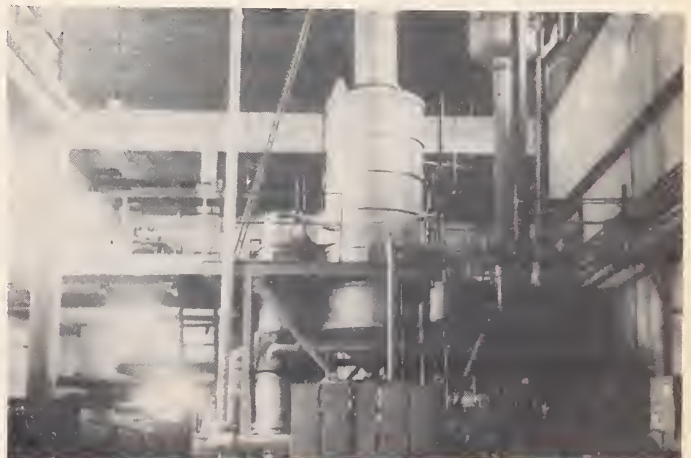




Left. Juice extractors  
at the Mission Orange  
plant near Coatepec.



Mixing tanks for citrus base at the  
Mission Orange plant near Coatepec.

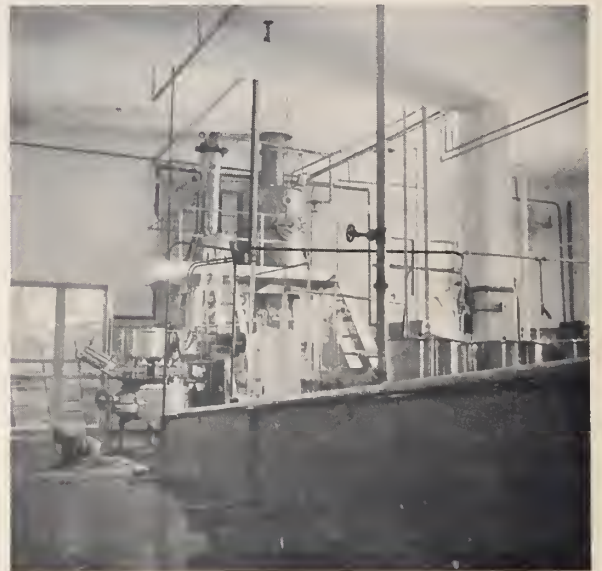
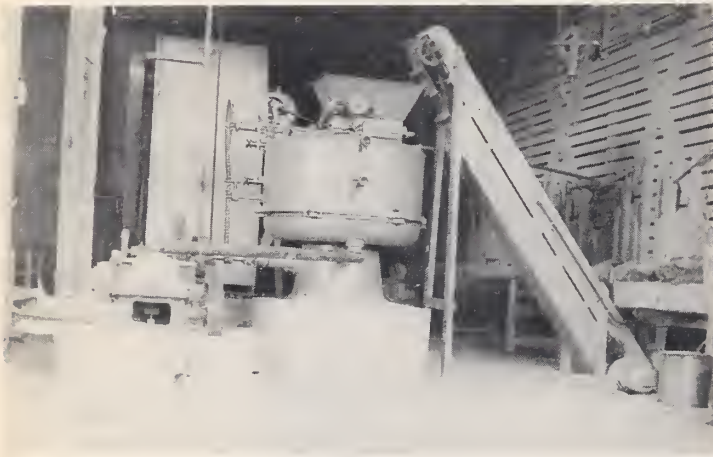


Right. Juice concentrator  
at the Mission Orange plant  
near Coatepec.

Right. The receiver of citrus peel and empty barrels used to cold store citrus concentrate for beverage bases (Mission Orange plant near Coatepec).



Left. An Italian machine for extracting the essential oil from the peel of limes before the juice is extracted from the fruit (Mission Orange plant near Coatepec).



The Nesbitt citrus processing plant at Monterrey.

Interior of the Nesbitt plant at Monterrey.



Table 7.--Essential oils (orange and lime); Exports from Mexico,  
by country of destination, 1940-50

Commodity and year	Country of destination		
	United States	Others	Total
	Pounds	Pounds	Pounds
Essential oil of orange:			
1940 . . . . .	0	9	9
1941 . . . . .	1,874	0	1,874
1942 . . . . .	6,195	26	6,221
1943 . . . . .	1,299	156	1,455
1944 . . . . .	0	68	68
1945 . . . . .	0	9	9
1946 . . . . .	9	0	9
1947 . . . . .	7	0	7
1948 . . . . .	2	40	42
1949 . . . . .	0	0	0
1950 . . . . .	0	212	212
Essential oil of lime:			
1940 . . . . .	16,063	33	16,096
1941 . . . . .	4,801	0	4,801
1942 . . . . .	62,815	7	62,822
1943 . . . . .	124,957	0	124,957
1944 . . . . .	92,214	0	92,214
1945 . . . . .	87,384	57	87,441
1946 . . . . .	73,135	0	73,135
1947 . . . . .	75,033	7	75,040
1948 . . . . .	84,954	0	84,954
1949 . . . . .	169,159	0	169,159
1950 . . . . .	197,825	0	197,825

Source: Compiled from official sources.

Lime juice. The production of single-strength lime juice has not proven satisfactory. No market has been found for lime juice packed in 4-ounce containers, and only small quantities of lime juice are used by bottlers since lime is not one of the more popular flavors.

Citric acid is again being manufactured in small quantities in Veracruz near Coatepec and in Michoacan at Apatzingan, but most of Mexico's citric acid is imported. Since 1940 the United States has been the primary source of these imports (table 8). Producers state that the imported product can be sold for less than the cost of the domestic product. Citric acid imports have been increasing recently in spite of the rather high import duties, which are equivalent to over \$0.08 per pound.

Table 8. --Citric acid: Imports into Mexico, by country of origin, 1939-50

Country of origin	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950
	: 1,000	: 1,000	: 1,000	: 1,000	: 1,000	: 1,000	: 1,000	: 1,000	: 1,000	: 1,000	: 1,000	: 1,000
	: pounds	: pounds	: pounds	: pounds	: pounds	: pounds	: pounds	: pounds	: pounds	: pounds	: pounds	: pounds
Germany . . . .	42	0	1/	0	0	0	0	0	0	0	11	236
Belgium . . . .	11	29	0	0	0	0	0	0	0	0	66	11
Czechoslovakia . . . .	4	0	0	0	0	0	0	0	0	92	183	44
United States . . . .	20	178	379	220	154	190	278	628	655	624	681	553
France . . . . .	0	0	0	0	0	0	0	0	0	0	0	2
United Kingdom . . . .	9	0	1/	0	0	0	1/	66	0	1/	0	20
Netherlands . . . .	0	0	0	0	0	0	0	0	0	0	0	51
Italy . . . . .	284	139	0	0	0	0	0	0	0	1/	0	0
Others . . . . .	1/	1/	0	1/	0	0	0	0	1/	1/	0	1/
Total . . . .	370	346	379	220	154	190	278	694	655	716	941	917

1/ Less than 1,000 pounds.

Source: Compiled from official sources.

Calcium citrate. Exports of calcium citrate from Mexico during the past 10 years were important only in 1942 when they totaled 701,000 pounds, over half of which went to Argentina and Colombia (see Table 9). Calcium citrate is not likely to be an important export item unless war upsets normal trade.

Table 9.--Calcium citrate: Exports from Mexico, by country of destination, 1942, 1948, and 1949 <sup>1/</sup>

Country of destination	1942	1948	1949
	1,000 pounds	1,000 pounds	1,000 pounds
United States . . . . .	22	0	7
Argentina . . . . .	280	0	0
Colombia . . . . .	220	0	0
Peru . . . . .	62	0	0
Uruguay . . . . .	77	0	0
Others . . . . .	40	15	0
Total . . . . .	701	15	7

<sup>1/</sup> Exports reported for other years between 1939 and 1950 did not exceed 1,000 pounds in any year.

Source: Compiled from official sources.

Grapefruit juice. Grapefruit is the most popular canned juice in Mexico, although fresh oranges (often of poor quality) are available nearly every month of the year. The market for canned single-strength juice in Mexico is limited since canned juice is considered a luxury product. Although only small quantities of single-strength grapefruit juice were canned in 1951, this product was still available in grocery stores in the fall of that year. At that time imported single-strength grapefruit juice was selling for about 75 percent more than the domestic product (table 10). Both consumer preference and high import duties contribute to the higher price of the imported juice.

Table 10.--Retail prices of canned single-strength grapefruit juice, Mexico City, December 1951 <sup>1/</sup>

Brand	Size of can	Retail price	
		Pesos	Dollars
Mexican Brand A <sup>2/</sup> . . . . .	#2	1.75	0.20
Mexican Brand B <sup>2/</sup> . . . . .	#2	2.20	0.25
Mexican Brand C <sup>2/</sup> . . . . .	16 oz.	1.05	0.12
Mexican Brand D <sup>2/</sup> . . . . .	16 oz.	1.20	0.14
United States Brand A (sugar added) . . . . .	#2 (1 pint, 2 fl. oz.)	3.75	0.43
United States Brand B (Texas - unsweetened) . . . . .	#2 (1 pint, 2 fl. oz.)	3.15	0.36
United States Brand C (sugar added) . . . . .	(1 quart, 14 fl. oz.)	8.90	1.03

<sup>1/</sup> As observed in supermarkets.

<sup>2/</sup> Grapefruit juice canned in Mexico.

Source: Compiled from official sources.



Orange juice. Mexico's most important orange product is concentrated orange juice for use in bottlers' bases. Consumption of soft drinks and bottled water is very high in Mexico, and an estimated 75 million to 95 million cases are sold each year. The soft drinks are mostly sweetened and carbonated, and bottlers estimate that about 50 percent are flavored with citrus, primarily orange. Although most of the soft drinks contain synthetic flavors, about half of the orange drinks contain some orange juice. Soft drinks are widely sold, and there is a small market in Mexico for United States bottlers' bases and essences, in spite of the large local production of citrus and citrus products. 3/

The quality of oranges available for processing in Mexico would seem to make possible the production of excellent quality single-strength orange juice and orange juice concentrate. In tests made by the Mission Orange Company of Mexico at its plant near Coatepec, Veracruz, the ascorbic acid content of orange juice averaged 77 mg. per 100 cubic centimeters of single-strength juice and 470 mg. per 100 grams of 65° Brix concentrate orange juice. These tests indicate that orange juice concentrate produced from Veracruz oranges may have a considerably higher vitamin C content than United States orange juice.

The Mexican fruitfly is present in all Mexican citrus districts, and since this pest lays its eggs in mature fruit on the tree the larvae of the fly and insect eggs are apt to be present in at least some of the orange and grapefruit juice produced. This fact would seem to limit Mexico's export possibilities for orange and grapefruit products.

#### Outlook for the Processing Industry

Mexico will probably have adequate supplies of fruit for processing, and the most important export products will probably be essential oil of lime and hot-pack concentrated orange juice for bottlers' bases. Essential oil of lime is the major processed citrus product exported to the United States, and exports may increase in the future as lime production increases in Michoacan. The presence of the Mexican fruitfly in all citrus districts will probably prevent the large-scale export of orange or grapefruit juice to the United States. Mexico's juice products will go to countries other than the United States. The present level of domestic consumption makes it seem unlikely that exports of orange juice concentrate will exceed 2,000 tons until existing processing facilities are considerably expanded. If the United States did not have an export payments program on concentrated orange juice, Mexico would probably export small quantities of this product to Europe.

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3/ See Appendix for "Requirements for the Registration of Processed Citrus Products to be Imported into Mexico."

## MARKETING

Citrus marketing in Mexico is not well organized, and most of the fresh fruit is marketed by small fresh-fruit buyers and exporters. Marketing organizations such as are common in the citrus industry of the United States are practically unknown in Mexico except in the northeastern part where growers own a few packing plants.

### Marketing Regulations

There are no marketing regulations for citrus fruit in Mexico for either domestic or export shipment. Mexican domestic markets are supplied with fruit the year around, not because of extended seasons of maturity, but because immature fruit is picked and sold in September and October, at least 2 months in advance of a reasonable maturity, and overmature fruit, often infested with larvae of the Mexican fruitfly, is sold in summer. As a result of the lack of any maturity or market grade regulations, the quality of oranges sold in the Mexican domestic market is often poor in spite of the fact that Mexican fruit, properly handled, is a very satisfactory product.

### Marketing Methods

Mexico's citrus marketing methods vary according to the variety of fruit and the market to be supplied.

Oranges for the domestic market are pull-picked and marketed in bulk, mostly through fresh-fruit buyers. Nearly all of this fruit is sold in an orchard-run condition, unsized, unwashed, ungraded, and unpacked. The domestic market is indiscriminating, and packed graded oranges offered for sale in the past have brought the same price as ungraded fruit. Most of the domestic retail outlets are street vendors who pile their fruit in the market or on a sidewalk. Oranges are widely used in Mexico, and many sidewalk orange juice stands are to be seen in most towns.

Most of the export oranges are also sold through fruit buyers, but these buyers usually operate on a larger scale than those serving the domestic market. Export oranges are also pull-picked, but they are graded, washed, sized, and packed, and the early varieties are colored by a color-add process. In 1951, the oranges observed being shipped to the United States were packed in a Mexican-made, wire-bound Bruce box. The fruit was all color-added and heat-sterilized and was being trucked to Texas citrus packinghouses for resale to truckers who would market the fruit mostly in the Midwest.

Fruit for Canada is shipped by rail, and fruit for Europe is trucked to dockside at Brownsville, Texas.

All facilities for the exporting of fresh oranges are in the three northeastern states of San Luis Potosi, Tamaulipas, and Nuevo Leon.



Grapefruit, a minor citrus variety in Mexico, is produced commercially only in Veracruz and Nuevo Leon. Both white and pigmented types are grown, and the fruit is sold in much the same manner as oranges. All the Veracruz production is sold domestically in bulk, while most of the production of Nuevo Leon is exported to the United States as packed fruit.

Limes are produced principally for export and are marketed in a different way from oranges, which are raised primarily for the domestic market. Nearly all the limes are graded at the source of production to separate the green export fruit from the colored limes which are sold in the domestic market and used for processing. Limes for the domestic market are packed, largely ungraded, in boxes or crates because the size of the fruit does not lend itself to the bulk handling methods used for oranges. Fruit sold to the United States is shipped by rail express to border packing plants where the fruit is regraded, sized, and repacked. Border repacking is carried on primarily at Nuevo Laredo, Mexico, and Laredo, Texas, and one small packing plant is reported to operate at El Paso, Texas. In 1951, four lime packing plants were operating at Laredo and one at Nuevo Laredo.

The fruit is shipped from the producing areas such as Apatzingan and Colima to the packing plants by rail express, which requires usually about 3 days shipping time. In 1951, the express charges were about \$1.04 per 66-pound box of fruit, and the average price of limes in the fall of 1951 was \$3.99 per box f.o.b. Apatzingan. Limes were costing the importer approximately \$5.03 per box at the border.

The limes are shipped to the border in the boxes used in the field where the fruit is grown. At the border these boxes are made smaller by cutting off the top third. The rebuilt boxes are then used to ship the regraded fruit to United States markets.

The uneven ripening of limes makes the regrading necessary, but if refrigerated transport were available in Mexico some of this might be avoided. Since all fruit is repacked at the border, the new packing equipment at Apatzingan would seem to have little advantage over more simple packing methods.

Sterilization of export limes. The United States Department of Agriculture Bureau of Entomology and Plant Quarantine, is carrying on work in Mexico to develop a dip process whereby export limes may be treated to eliminate the possibility of carrying red scale and blackfly into the United States. It has been found that when boxes of limes contain infested material there is a period of nearly 2 weeks in which there is a danger of live flies emerging to create a new infestation. A method of treatment is now under consideration and if put into use will help to eliminate the possibility of Mexican limes carrying scale and pests into the United States.

Sweet lemons are produced primarily at Atotonilco El Alto in Jalisco. This nonacid fruit is enjoyed by Mexicans and is sold on the domestic market only. The most common manner of display for retail sale is to tie about a dozen lemons on a stick, a marketing method peculiar to this type of fruit.





A typical rural market stand  
retailing oranges.



Unloading a truck which has brought  
Veracruz oranges to Mexico City.



A stand in Mexico's wholesale  
fruit market.



Left. A plant at Laredo, Texas,  
where Mexican limes are repacked.



The field boxes in which limes  
are shipped to the border are  
cut down, as on the right, and  
used to ship repacked limes to  
United States customers.

Tangerines. Considerable quantities of tangerines are produced in northeastern Mexico, primarily in San Luis Potosi and Nuevo Leon. This fruit is marketed by the same bulk handling methods used for oranges. Tangerines are now being exported to the United States and are packed and sterilized in much the same manner as oranges.

### Export Marketing

Limes. Limes have long been Mexico's major export citrus crop, and nearly all fruit exported has gone to the United States. Exports to the United States have not changed greatly since 1940 and do not reflect the steady increase in Mexican production.

Mexican fruit competes with limes from Florida in the United States market. (Production in the two areas is compared in table 11, and monthly shipments in table 12.) Mexico's production is much larger than Florida's, but between 1940 and 1949 the production of limes increased at approximately the same rate in Florida and Mexico. Both areas ship limes in every month of the year, and shipments are usually highest in the summer months from June through September. During the 12-month period, August 1950 to July 1951, Mexico supplied about one-third of the total United States lime requirements, and only in May 1951 did imports of Mexican limes exceed Florida shipments.

Mexico will continue to be a major source of limes for the United States market. Because of the growing lime production in Mexico and the improved transport facilities made possible by the new highway construction in the lime producing areas, lime exports are likely to increase in the future.



Mexican limes being sight-graded for color before being repacked at Laredo.



Grading Mexican limes in a plant at Laredo.



Table 11.--Limes: Production in Mexico compared with production in Florida, and Mexican exports to the United States, 1940-50

Year	Production		Exports from Mexico to the United States 2/
	Florida 1/ 1,000 boxes	Mexico 2/ 1,000 boxes	
1940 . . . . .	95	898	71
1941 . . . . .	80	1,023	81
1942 . . . . .	150	1,110	53
1943 . . . . .	175	1,175	78
1944 . . . . .	190	1,207	21
1945 . . . . .	250	1,502	15
1946 . . . . .	200	1,682	53
1947 . . . . .	170	1,684	49
1948 . . . . .	170	1,751	3/
1949 . . . . .	200	1,792	3/
1950 . . . . .	260	-	93

1/ Crop-year basis.

2/ Calendar-year basis.

3/ Exports of limes were not reported separately during 1948 or the first 9 months of 1949.

Sources: Florida Citrus Mutual and Direccion General de Estadistica.

Table 12.--Limes: Exports from Mexico compared with shipments from Florida, August 1950 to July 1951

Year and Month	Mexico	Florida Shipments
	Boxes	Boxes
1950:		
August . . . . .	9,259	34,653
September . . . . .	8,212	18,846
October . . . . .	4,437	10,102
November . . . . .	3,169	12,470
December . . . . .	2,370	6,357
1951:		
January . . . . .	3,334	10,848
February . . . . .	2,260	4,388
March . . . . .	5,043	6,084
April . . . . .	4,519	5,262
May . . . . .	14,633	2,667
June . . . . .	16,397	36,789
July . . . . .	9,370	59,082
Total . . . . .	83,003	207,530

Sources: Direccion General de Estadistica and Florida Citrus Mutual.



Oranges have not been an important export crop in Mexico until recent years. With the exception of 1943, no major quantities were exported until 1949 and 1950 (see table 13). In 1950 Mexico exported over 900,000 boxes of oranges, most of them going to the United States and Canada. As north-eastern Mexico recovers from drought and frost damage, exports will continue, and the United States and Canada will probably be Mexico's largest export markets.

Table 13.--Oranges: Exports from Mexico, by country of destination, 1940-50

Year	United States	Canada	Sweden	Norway	Cuba	Belgium	Total
	Boxes	Boxes	Boxes	Boxes	Boxes	Boxes	Boxes
1940	0	0	0	0	0	0	0
1941	0	0	0	0	1/	0	1/
1942	9	0	0	0	0	0	9
1943	65,112	35,825	0	0	0	0	100,937
1944	0	0	0	0	0	0	0
1945	0	0	0	0	0	0	0
1946	0	0	0	0	0	0	0
1947	3,937	0	409	0	0	0	4,346
1948 2/	-	-	-	-	-	-	-
1949	16,907	32,989	0	0	0	18,438	68,334
1950	762,161	141,923	0	125	0	0	904,209

1/ Less than 1 box.

2/ Exports of oranges were not reported separately during 1948. These exports were included during that period under fraction 24.10 comprising citron, limes, lemons, and oranges as follows:

	Boxes
United States ..	220,428
Canada .....	1,260
Total .....	221,688

Source: Direccion General de Estadistica.

Mexico's export season, which is indicated by the monthly export figures shown in tables 14 and 15 for 1950 and 1951, is comparable with Florida's shipping season. The color-added Lisa oranges, a group which consists of mixed types such as Parson Brown, Hamlin, Pineapple, and San Miguel, are exported from November to March. After March, most export shipments consist of the Valencia, which is not usually subjected to a color-add process.

Table 14.--Oranges: Exports from Mexico, by port and month, 1950

Month	Laredo	Matamoros	Other ports	Total
	<u>Boxes</u>	<u>Boxes</u>	<u>Boxes</u>	<u>Boxes</u>
January . . . . .	65,981	45,257	0	111,238
February . . . . .	113,600	36,659	0	150,259
March . . . . .	129,914	2,236	63	132,213
April . . . . .	129,095	11,338	63	140,496
May . . . . .	59,997	20,062	0	80,059
June . . . . .	40,470	15,432	0	55,902
July . . . . .	10,582	0	0	10,582
August . . . . .	0	0	0	0
September . . . . .	0	0	0	0
October . . . . .	36,124	0	1/	36,124
November . . . . .	123,898	13,165	0	137,063
December . . . . .	47,443	2,830	0	50,273
Total . . . . .	757,104	146,979	126	904,209

1/ Less than 1 box.

Source: Direccion General de Estadistica.

Table 15.--Oranges: Exports from Mexico, by port and month, January-October, 1951

Month	Laredo	Matamoros	Veracruz	Ciudad Juarez	Total
	<u>Boxes</u>	<u>Boxes</u>	<u>Boxes</u>	<u>Boxes</u>	<u>Boxes</u>
January . . . . .	37,193	11,656	0	0	48,849
February . . . . .	43,903	12,697	413	0	57,013
March . . . . .	6,796	5,358	0	0	12,154
April . . . . .	0	0	120	0	120
May . . . . .	0	0	0	0	0
June . . . . .	0	0	0	2	2
July . . . . .	0	15,521	0	0	15,521
August . . . . .	0	0	0	0	0
September . . . . .	0	0	0	0	0
October . . . . .	4,702	0	0	0	4,702

Source: Direccion General de Estadistica.



## Outlook for Marketing Oranges

The potential orange production of the 1953-54 season has been estimated at 22 million boxes. If this potential is realized, even if exports are increased materially, it is doubtful whether the domestic market can absorb that large a crop at prices which growers will consider satisfactory. Since Nuevo Leon is not so favorably situated with regard to the Mexico City market as is Veracruz, fruit in northeastern Mexico may sell at very low prices in the future. These low prices will probably discourage an extension of plantings, although new areas suitable for citrus are being brought under irrigation. The new highways being built will aid in distributing new production, but as production approaches 22 million boxes, or about 1 box per capita, it is likely that domestic marketing difficulties will occur, and there are no orderly marketing programs in Mexico to aid growers.

In the future Mexico will probably export more oranges than in the past; however, total exports are unlikely to increase as rapidly as production. Since the early oranges shipped from November through March will probably all be color-added fruit, it is unlikely that a European market can be developed for this fruit, and oranges exported in this season will be sold on the North American continent. After March the Valencias may find a European market, and it is at this season and with this variety that Mexico will be most competitive in international trade. The Valencia, however, is not raised in large quantities at this time.

The mixed planting and handling of the Lisa early oranges creates uneven packs, and the poor cultural practices probably present an equally important problem. The fact that one-third of the planted area in Nuevo Leon is un-irrigated creates problems of uneven maturity since drought-breaking rains cause out-of-season blooms.

Mexico can produce excellent quality fruit but the cultural practices will probably continue to result in uneven grades of fruit which are not a very good basis for creating a large export market. The shipment of frozen oranges to Canada has injured Mexico's reputation there, and the color-added mixed packs of early varieties will probably find a market in the United States on a price basis only.

Costs are favorable in Mexico. Data obtained at Linares indicate that in the 1950-51 season an exporter could pay growers \$0.72 per thousand fruits, which was considered a good price, and pack and ship a box of oranges to the border at Laredo for \$2.17 per packed box, including the cost of sterilization. Considering these factors Mexican packed oranges can be sold at the border for a break-even cost of about \$2.00 per packed box, less Mexican and United States duties.

Mexico can adequately supply the domestic market, but it has not yet developed the disciplined industry it must have in order to become a major supplier of oranges to international markets.



## COLIMA

The State of Colima is important in citrus primarily for the production of limes. Great changes have taken place in the past 10 years, and most of the groves that were important in 1940 have either been removed or abandoned. A new lime area has been developed near Tecoman on the coastal plain beginning about 25 miles east of Manzanillo, and in the future most lime production will come from this area. The older lime groves were mostly unmixed plantings; the new groves near Tecoman are mostly mixed plantings with coconuts and bananas, and limes appear to be a secondary crop to coconuts. The mixed planting method used in the new groves, the continuous removal of old plantings, and the lack of control of the blackfly all limit production. The new highway will make marketing easier, but no great increase in lime production should be expected from Colima. Crops such as cotton and coconuts may prove to be more profitable than limes, and most of the new acreage is being used for these noncitrus crops.

As a lime district, Colima follows much poorer cultural and marketing practices than does Veracruz or Apatzingan, Michoacan, which has replaced Colima as the leading lime area.

Number of Trees and Production

The infestation of the blackfly caused many older groves to be abandoned in 1946 and 1947, and, as a result, much of the producing acreage that was important 10 years ago has been removed.

Table 16.--Limes: Number of trees, acreage, and production, Colima, 1939, 1949, and 1951

Source and year	Number of trees	Acreage	Production
	Producing	Acres	Boxes
Official 1939 . . . . .	154,000	2,414	176,285
Official 1949 . . . . .	355,000	5,841	397,104
	All trees		
Trade 1951 . . . . .	1/ 300,000	2,471	275,575

1/ Total number of trees; includes 160,000 bearing and 140,000 nonbearing trees.

Source: 1939 and 1949, Boletín Mensual de la Dirección de Economía Rural, Secretaría de Agricultura y Ganadería; 1951, trade sources and personal estimates made from observations in the field.

In table 16 the difference in acreage between 1949 and 1951 does not mean that an acreage reduction has taken place in the last few years but rather that the official statistics do not reflect the reduction that took place prior to 1949, particularly in 1946 and 1947.

The 1951 estimate of 300,000 trees seems reasonable from observations in the field. Trade sources estimate that 160,000 trees are in production and that 140,000 are young, nonbearing trees. New planting is continuing near Tecoman; however, a considerable proportion of the present bearing acreage is in old, poorly maintained trees, many of which will probably be removed in the next few years.

Observations in the field indicate that the production of limes in Colima in 1951 is not more than 276,000 boxes. Although over 40 percent of the acreage was in young nonbearing trees in 1951, production is not expected to increase much in the near future as the removal of old trees and the mixed planting of new acreage will tend to limit increases.

### Climate

Colima has a milder climate than Apatzingan, Michoacan, which has become the most important lime producing area (see tables 17 and 20). The average maximum temperature in Colima is less than 100° F. in 4 months in the year. Rainfall averages 28.36 inches per year at Colima, but in 7 months of the year the average precipitation is insufficient for citrus. During November, December, and January rainfall is higher at Colima than at Apatzingan, which also has a 7-month dry period.

The coastal area near Tecoman has a higher rainfall than does Colima. Official data were not available, but growers who keep rainfall records stated that the average rainfall is about 40 inches a year near Tecoman.

All the lime districts in the State of Colima are free from damaging frosts.

Table 17.--Monthly data on climate at Colima, Colima, 1931-40

Month	Temperature			Relative Humidity	Total Rainfall	Days with Frost
	Average	Maximum	Minimum			
	(°F.)	(°F.)	(°F.)	(Percent)	(Inches)	
January	72.50	99.50	46.40	64	1.00	0
February	73.40	100.94	47.30	63	.38	0
March	74.66	103.28	50.36	60	.03	0
April	77.00	104.36	47.30	55	0	0
May	78.98	104.90	53.96	60	.17	0
June	79.88	104.36	60.08	70	4.42	0
July	78.62	103.28	59.90	75	8.09	0
August	73.58	100.40	64.04	78	7.29	0
September	78.26	97.70	63.14	80	6.89	0
October	78.08	100.40	60.80	76	3.02	0
November	75.92	98.42	48.56	70	.57	0
December	73.40	98.96	49.28	66	.53	0
Annual	76.10	104.90	46.40	68	28.36	0

Source: Secretaria de Agricultura y Ganaderia, Servicio Meteorologico Mexicano.



## Cultural Practices

Cultivation. Most of the young groves near Tecoman are cultivated by disc harrows and tractors, while the older orchards near Colima are usually cultivated by hand. Many of these older groves were abandoned in 1946 and 1947, and attempts are now being made to return a few of them to commercial production. One large grove near Colima was seen where a nontillage culture is being practiced, the weeds being cut by hand two or three times a year.

Size of groves. The groves are large, usually containing over 50 acres.

Irrigation. All of the lime groves in Colima are irrigated since there is little or no rainfall from October to June. The coastal area in which limes are raised is at the foot of the high continental plateau, and has ample water resources. The Aleman canal, which was completed in 1950, will use the waters of the Armeria River to irrigate 2,000 hectares (4,942 acres) in the Tecoman area. 4/ About a third of this area was under irrigation by the fall of 1951. Another project under construction will take the waters of the Tuxpan River to Lake Amela, which will be used as a reservoir for the Tecoman area. Although the land irrigated by the new developments is suitable for the production of limes, the primary crops will probably be coconuts, cotton, sesame, and bananas.

Pruning. The primary pruning practice is to raise the skirts of the trees to at least 3 feet and sometimes as much as 5 feet. Some of the better growers also remove deadwood.

Pest and disease control. The most serious disease in Colima is gummosis. This disease attacks the lime seedling trees, but no sour orange rootstock is used, although one grower stated that the lime budded on sour orange stock made a stronger tree. The disease is treated in some groves by scraping and disinfecting the diseased area.

The deformed lime fruits seen in one grove were probably the effect of anthracnose or bud mite.

The most serious pest in the area is the blackfly which gained such headway in 1946 and 1947 that many groves were abandoned. In the fall of 1951 a heavy infestation of this pest was seen in every part of the area visited. Growers state that they hope that biological control will be established. The infestation seems to be decreasing; some growers have found that groves that were heavily infested in 1946 and 1947 now produce a commercial crop of fruit although they are still infested. Some effort at quarantine has been made, but the present quarantine efforts do not seem to be strict enough. Unlike the State of Veracruz, Colima has no growers' committee to fight the pest, and no grower was found who was spraying for blackfly. Since growers are relying on biological control, spraying might not be advisable. However, as a general practice, this district does not have a pest control program for any citrus pest. Under present conditions

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4/ From a report by Richard A. Johnson, American Consul, American Consulate, Guadalajara, Jalisco.





**A typical old seedling lime grove at Colima.**



**A young seedling lime grove near Tecoman. Note pruning practice.**



**Young seedling lime trees interplanted with coconuts near Tecoman. Much of the new lime acreage is in mixed plantings of this type.**



**A grower's lime packing shed near Colima.**

the future of Colima as a lime producing area depends on the success of biological control. There seems to be some hope that success will be achieved, but it will be several years before the outcome is known and, in the meantime, the infestation will limit production.

Rootstocks. All limes in the Colima area and all new plantings in Tecoman are seedlings. The young trees grow rapidly and growers say that a 3-year-old, well-grown tree will produce 65 pounds of limes.

Fertilization. In the past, most limes were grown without fertilization; however, some growers are now beginning to use sulfate of ammonia on bearing trees.

### Marketing

Limes for processing are pulled from the trees with hooks mounted on poles, and export limes are picked with poles equipped with small containers, canvas bags, or "double spoons" of metal which prevent the picked fruit from dropping on the ground. Pickers are paid \$0.21 to \$0.25 per box. The picked fruit seen had uncut stems. Fresh fruit is wiped clean with a rag and receives no other preparation. There is no marketing organization, and the fresh fruit is sold to fruit buyers.

Nearly two-thirds of the limes produced are used for processing, about one-fifth of the production is sold for domestic use as fresh fruit, and another one-fifth is exported.

Table 18.--Limes: Estimated utilization of Colima production in 1950 <sup>1/</sup>

Production:	Utilization	Estimated average sales price--Colima
<u>Boxes</u>	:	<u>U. S. dollars per box</u>
165,345	: Processing . . . . .	0.84
55,115	: Domestic consumption:	1.16
55,115	: Export . . . . .	2.31
<u>275,575</u>	:	

<sup>1/</sup> Trade sources.

There are no indications of any change in the present marketing pattern, and the quantity of fruit sold fresh as compared with that processed will depend on the price of essential oil of lime and the price of limes exported to the United States.

At present all fresh fruit is shipped by rail in unrefrigerated cars, since roads into Colima are practically impassible. This situation will be changed in 1952 when a new paved road will connect Manzanillo, Tecoman, and



Colima with the main highway system. Work is proceeding rapidly on this construction; most of the section from Colima to Manzanillo is paved and most of the grading and bridge construction is complete. Rock crushers on the road from Colima to Tecoman work day and night except on Sunday. This new highway will facilitate the marketing of fresh fruit from the area, and limes for domestic consumption will probably be shipped by motor truck when the highway is completed.

### Some Economic Factors

Value of land. The Tecoman area is going through a boom period as additional land is brought under irrigation. Land values are increasing, and property that 10 years ago could be purchased for \$0.23 per acre now sells for \$47.00 per acre. The value of lime groves has also increased, and growers state that \$117.00 per acre would be a low price for a producing grove today.

Wages. The new activity in the Tecoman area has increased employment opportunities, and the current wage for farm workers is \$1.16 to \$1.39 per day, which is twice the legal minimum wage. During harvest the workers are paid more. The farmers are beginning to use labor more effectively to reduce costs, and large quantities of new farm machinery were seen in the district.

Taxes. Taxation is increasing, and growers state that taxes on lime groves are \$0.28 to \$0.56 per acre per year, one-half of which is state tax and one-half municipal tax. In addition, there is a state tax on the quantity of fruit harvested.

Cost of operation. Growers interviewed indicated that the costs of operating a lime grove ranged from \$10.00 to \$14.00 per acre per year. One grower who had free gravity water, itemized his costs as follows:

<u>Item</u>	<u>Pesos</u> <u>per hectare</u>	<u>U. S. dollars</u> <u>per acre</u>
Weeding four times a year ....	100	4.69
Irrigation (labor only) .....	12	0.56
Fertilization .....	85	3.98
Taxes .....	12	0.56
Total .....	209	9.79

Cost of production. Considering that the average planting is about 120 trees per acre and that an average tree in good condition will produce 130 pounds of limes per year, the cash cost on the tree of raising limes at Colima is about \$0.12 per tree or about \$0.06 per box. In considering these costs it should be kept in mind that these are cash costs only, that cultivation and transport equipment are very expensive, and that growers must receive good returns to meet their capital costs.

The rapidly changing conditions in the district will probably result in increased costs of production.



# MICHOACAN

The State of Michoacan is the largest producer of limes in Mexico. The industry centers around Apatzingan, which is the primary source of export fruit in Mexico, and also the principal lime processing center. In the past decade great changes have taken place in this area, and the present rapid development of paved highways, electric power, and irrigation indicate that changes in the next 10 years may be even greater. Michoacan limes are preferred by the lime importers, and the roads will undoubtedly assist in the marketing of the growing production. This excellent lime district will continue to be the most important in Mexico.

## Acreage and Production

Lime acreage has increased more rapidly than official statistics indicate, and the estimated 15,000 acres now planted may be increased by another 2,500 acres in the next 2 years.

Table 19.--Limes: Numbers of trees, acreage and production, Michoacan, 1939, 1949, and 1951

Source and year.	Number of trees	Acreage	Production
	Producing	Acres	Boxes
Official 1939	126,000	1,974	155,067
Official 1949	302,000	4,979	346,095
	All trees		
Trade 1951 . . .	800,000-900,000	14,826	647,408-826,725

Source: 1939 and 1949, Boletín Mensual de la Dirección de Economía Rural, Secretaría de Agricultura y Ganadería; 1951, trade sources and estimates from personal observation.

As the industry has grown and new areas have been developed, the important centers of production have changed. Ten years ago the "ejidos" at Nueva Italia, Lombardia, and California were the most important sources of limes. These properties are still producing limes, but most of the commercial production comes from new private groves west of Apatzingan near El Rosaria and Chandio, Las Colonias, Galana, Pinzandaro, Santa Ana, and Guarachito.

The Apatzingan lime industry is growing, and production may be expected to be a third above present levels by 1957 when 1,100,000 boxes of fruit may be produced.

## Climate at Apatzingan

The climatic data for Apatzingan is given in table 20. This climate is considered to be practically ideal for the production of limes, and the average maximum temperature exceeds 104° F. in every month of the year. Although Apatzingan has an average annual rainfall of 27.63 inches, there are 7 months of dry weather beginning in November and extending through May when irrigation is necessary. Apatzingan is free from damaging frosts.

Table 20.--Apatzingan, Michoacan: Monthly data on climate 1931-1940 1/

Month	Temperature			Total rainfall	Days with frost
	Average	Maximum	Minimum		
	°F.	°F.	°F.	°F.	°F.
January . . . . .	77.54	105.80	48.20	0.28	0
February . . . . .	79.88	109.40	46.40	0.14	0
March . . . . .	82.22	109.58	53.60	0.08	0
April . . . . .	85.82	108.50	59.00	0.16	0
May . . . . .	88.52	109.40	64.40	0.38	0
June . . . . .	87.80	109.40	68.00	3.70	0
July . . . . .	83.48	105.80	66.20	7.64	0
August . . . . .	82.94	105.80	60.80	7.59	0
September . . . . .	82.76	104.90	66.20	5.59	0
October . . . . .	84.02	109.40	64.40	1.44	0
November . . . . .	80.78	105.80	52.70	0.16	0
December . . . . .	78.08	106.70	46.40	0.46	0
Annual . . . . .	82.76	109.40	46.40	27.63	0

1/ Secretaria de Agricultura y Ganaderia, Servicio Meteorológico Mexicano. These data were obtained through the kindness of Mr. Arnold P. Eliot, U. S. Weather Bureau Liaison Officer, American Embassy, Mexico, D. F.

## Cultural Practices

Size of groves. Lime groves near Apatzingan are mostly large properties (see table 21). Over half of the acreage controlled by the Union de Citricultores de Michoacan is in 12 groves, each of which contains over 250 acres. Members of the Union are planting 1,821 acres of new large groves, the smallest of which will contain 371 acres.





A well-grown seedling lime tree in a grove near Apatzingan. This is typical of good citrus culture in privately owned groves.



Young lime replants in a coconut grove at Hacienda California. Old lime trees are being replaced.



Seedling lime trees ready for orchard planting (Apatzingan).



Young lime grove near Apatzingan.



Right. A balled lime tree with the ball wrapped in palm leaves.





Spray rig of the type used to control the blackfly at Apatzingan.



Spraying lime trees for blackfly at Apatzingan.



Infestation of blackfly on leaves of a lime tree near Apatzingan.



Table 21.—Limes: Size of groves owned by members of the Union de Citricultores de Michoacan at Apatzingan, Michoacan, 1951

Size of grove	Number of groves	Total acreage
		<u>Acres</u>
Less than 25 acres	27	405
25-49 acres . . .	16	504
49-99 acres . . .	7	385
99-148 acres . . .	3	351
148-198 acres . .	3	494
198-247 acres . .	1	198
247-297 acres . .	9	2,249
297 acres and over	3	991
		<u>5,577</u>

Source: Compiled from data supplied by Mr. A. Chavez, Director of the Union de Citricultores de Michoacan at Apatzingan.

Cultivation. Extensive citriculture is practiced, and most groves are cultivated with tractor-drawn disc harrows. However, one of the best groves seen was cultivated by hand tillage.

Only seedling trees are raised and these grow vigorously and produce well. They are rather short-lived, however, and have to be replaced when about 20 to 25 years of age. Thousands of young seedling trees are being raised and planted both by private growers and the ejidos. Trees are usually planted 30 by 30 feet, which is a greater planting distance than is used in Colima.

The better-cared-for groves are fertilized, and the trees have dense, dark green foliage.

Most groves are an unmixed planting, but some limes are grown as inter-plants with coconuts.

Pest and disease control. The most serious disease is gummosis, and some growers paint the tree trunks with a fungicide as a control measure. The blackfly is the most serious pest. In 1951, a committee formed to combat the blackfly was using 10 spray rigs and an oil spray with rotenone. Where the spraying is well done, a good commercial control has been obtained. The committee attempts to spray every 45 days but has been able to treat infested groves only about every 2 months. The condition of the groves seen indicates that a fairly good commercial control is being obtained. The blackfly has reduced the yield of groves, and repeated oil spraying is found to be somewhat injurious to the trees. Michoacan has a quarantine against the blackfly,

but it is not effectively enforced. Infested material could easily be carried through the quarantine stations as they were operated in the fall of 1951.

### Marketing

Export limes are pole-picked from the tree, and caught in a canvas bag attached to the pole. Many of the fruits are picked with stems one-fourth of an inch long. The pickers carry the fruit to the field bins, and each picker puts his fruit in a separate bin in order to account for the quality picked. The limes are dumped from the bins into boxes and transported to the packing-house by trucks.

In 1951 trade sources indicated that growers were paid an average of \$1.26 to \$ 1.47 per box of 70 pounds for fruit.

Limes are packed at Apatzingan and also at Uruapan, which is not a producing area but which was the railroad terminus a little over 10 years ago.

The packing plants at Uruapan are small, and here the packing process consists of dumping the limes on a small grading table or in a bin and hand-sorting the fruit. The sorters remove the yellow limes for sale in the domestic market, and empty the green limes for export into the boxes used to bring the fruit from the field. Usually, a paper liner is used in packing the export quality fruit. Some of the limes are sized, some are not. No facilities for washing or waxing fruit were seen at Uruapan.

Apatzingan has large, modern lime packing facilities which wash, wax, and calibrate the fruit mechanically, and all grading is done on conveyor-type grading tables. Here, too, the shipping container used is the box used to bring the fruit from the field. This plant is reported to pack from 100 to 700 boxes of fruit per day for the domestic market, depending on the season, and an average of 200 boxes of export fruit per day. The ripe yellow fruit is graded out by hand for the domestic market. The all-green fruit is exported. It is shipped unstemmed, and the stems dry and shed in the repacking process at the border. Not all the limes packed are waxed, since some domestic markets prefer unwaxed fruit; however, in the fall of 1951 all export fruit was being washed and waxed. Since the plant did not begin operations until 1951, it is too early to evaluate the advantage of the waxed over the nonwaxed export fruit. Importers are not in agreement on the benefits of washing and waxing limes. Only one of the importers interviewed believed that the waxed limes held up better; others had seen no difference. Some importers expressed the opinion that washing was harmful to the keeping qualities of the fruit.

The export fruit is shipped by rail express from Apatzingan and Uruapan to Laredo, Texas, and Nuevo Laredo where most export purchasers have receiving plants. The shipping cost is about \$1.04 per box of about 66 pounds.





Picked limes are carried to orchard bins where each picker is credited with the amount of fruit picked. The bins are emptied into field boxes, and the limes are then trucked to the packing or processing plant.



Trucks unloading limes and loading empty field boxes at a packing plant, Apatzingan.



Calibration of limes at a packing plant, Apatzingan.



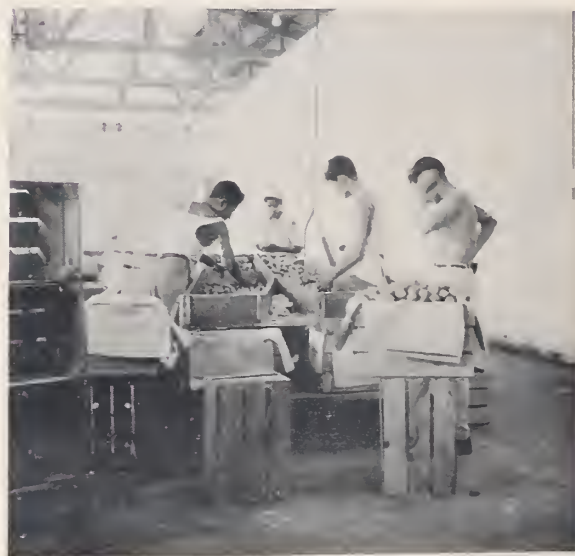
Grading limes in a packing plant at Apatzingan.



A modern lime packing plant at Apatzingan with driers at right and modern conveying equipment.



Packing limes for the domestic market, Apatzingan.



Waxed limes being packed in paper-lined boxes for export, Apatzingan.



Limes require rapid transport. The fruit must be re-sorted at the border because the limes mature unevenly in transport. The faster the fruit is moved, the easier it is to maintain an even grade. It now takes about 3 days for an express rail shipment to reach the border.

Shippers report that in the fall, after the rainy season in Apatzingan, little decay is found in fruit at the border; in summer, however, decay is sometimes high, and shipments made in unrefrigerated cars by ordinary freight in 1951 were unsatisfactory owing to decay. The use of refrigerator rail cars would be desirable for summer export shipments, but this type of car is very difficult to obtain in Mexico. When the new highway is completed, express shipments by truck may replace present rail handling and help solve some of the transportation problems.

An attempt has been made to unify the shipping and sale of limes at Apatzingan, but in the fall of 1951 the industry was divided by disagreements. The large shipping organization retained about 25 to 50 percent of the volume; the balance was handled by several fruit growers and buyers at Apatzingan and Uruapan.

Apatzingan is considered the best lime producing area and will continue to supply most of Mexico's export fruit. For export, its smooth-skinned fruit is preferred to the usually thicker-skinned Colima lime.

#### Economic Factors

The economy of the Apatzingan valley is being changed rapidly by the Tepalcatepec project under which a paved highway is being completed to Apatzingan and a large hydroelectric project is bringing electric power to the valley and making possible the extension of irrigated agriculture. The highway will be completed in 1952, and new irrigation pumps were being installed in 1951. This is one of the most rapidly developing agricultural areas in Mexico, and limes, cotton, corn, and sesame will be important crops.

The general pattern will be that of extensive agriculture using mechanical tillage.

The value placed on the lime industry is indicated by the fact that although lime groves could be sold for approximately \$234.00 per acre in 1951 few sales were reported.

The costs entering into the development of a new lime grove in this area are listed in table 22. Since limes bear heavy crops at Apatzingan and the cost of bringing a grove to bearing age in 4 years is not excessive, growers should find lime production a profitable operation in this area.

Table 22.--Mexico: Cost per acre of planting  
124 acres in limes, Apatzingan, Michoacan,  
1951 <sup>1/</sup>

Item	: Dollars : per acre
Clearing 124 acres at the rate of \$18.73 per acre . . . . .	: : 18.73
Soil preparation, including rooting out, plowing, second plowing, and harrowing at the rate of \$14.03 per acre . . . . .	: : : 14.03
Planting 6,000 trees 1 year of age, placed at a distance of 29.5 feet from each other, in a chess-like manner, and digging irrigation ditches . . . . .	: : : : 14.03
Weeding, hoeing, pruning, and arri- gation for 4 years . . . . .	: : 56.19
Irrigation quota at the rate of \$57.85 a year for 4 years . . . . .	: : 1.87
Interest on capital invested at the rate of 8 percent per year for 4 years . . . . .	: : 33.57
Property tax at the rate of \$0.92 per thousand for 4 years . . . . .	: : 3.37
Total . . . . .	: 141.79

<sup>1/</sup> Does not include original value of land or cost, if any, of fertilizing and pest control. Refers only to expenses incurred before the production period starts. This grove uses gravity irrigation.

Source: Union de Citricultores de Michoacan, S. A. de C. V., Apatzingan, Michoacan.



## VERACRUZ

Citrus plantings have increased greatly in the State of Veracruz in the past 10 years, particularly in the postwar period. Thousands of newly planted lime and grapefruit trees can be seen in the coastal area and tens of thousands of new orange trees in the foothill region. Excellent control has been established over the blackfly and, although the current interest in coffee production may limit the expansion of citrus plantings to some degree, the production of oranges is expected to increase in the next few years.

Most of the fruit produced is of good interior quality, but because of the poor appearance which results from the practice of interplanting citrus with coffee the fruit is suitable only for domestic sales or processing. The new plantings of Valencia orange trees may change this situation, but the majority of the Valencias will probably be sold on the domestic market where there is a demand for late oranges in the spring and early summer.

### Citrus Districts

The citrus districts of the State of Veracruz may be roughly divided into two regions: (1) the low coastal plain, and (2) the high districts on the slopes of Mount Orizaba.

The coastal area is warm and humid but has less rainfall than the higher area. Grapefruit and limes are planted in the coastal section; in addition, wild limes grow in this section, and some of them are harvested for local use. The principal coastal citrus area is near Veracruz. Some groves in the coastal area have been abandoned because of the hazard of the north winter winds.

The major citrus districts are on the slopes of Mount Orizaba near Jalapa, Coatepec, Xico, Fortin, and Cordoba. The largest plantings of oranges are found here and the areas around Coatepec and Jalapa are the most important. The soil in this area is ideal for citrus; the pH of soils near Coatepec ranges from 6.33 to 6.56. 5/

In the past 10 years all the districts have been expanded, but the greatest growth was observed in the vicinity of Jalapa. Ten years ago Jalapa had almost no citrus industry; today hundreds of acres of new orchards stretch south of Jalapa toward Coatepec and east of Jalapa on the rolling hills on both sides of the road leading to Veracruz.

The Department of Agriculture of the State of Veracruz reports that less important commercial citrus plantings are to be found near Cosautlan, Cuichapa, Tepatlaxco, Chacaltianguis, Tlapacoyan, Gutierrez Zamora, and Tuxpan. 6/

5/ From a report by Dr. Walter Edeling, obtained through the kindness of Mr. Charles J. Duffy, Manager of the Mission Orange Plant at Coatepec.

6/ For an excellent description of the citrus areas of Veracruz see F. A. Motz and L. D. Mallory, The Fruit Industry of Mexico, Office of Foreign Agricultural Relations, U. S. Department of Agriculture, Washington, D. C., April 1944.

# Number of Trees and Production

Oranges. The plantings and production of oranges in the State of Veracruz have increased rapidly in the past 10 years (see table 23). Both the State Government and trade sources indicate that actual production is considerably larger than indicated in the official statistics. The State of Veracruz Department of Agriculture estimate of 5 million trees in 1951 would seem to be approximately correct; however, about 20 percent of the trees are probably not commercial. In 1951 the rate of new plantings declined somewhat because high prices stimulated an increasing interest in coffee production.

Table 23.--Oranges: Number of trees, acreage, and production, Veracruz, 1939, 1949, and 1951

Source and year	Number of trees	Acreage	Production
	<u>Producing</u>	<u>Acres</u>	<u>Boxes</u>
Official 1939 . . .	732,000	11,448	1,419,668
Official 1949 . . .	1,073,000	17,673	2,433,123
	<u>All trees</u>		
Trade 1951 . . . . .	1/ 5,000,000	2/ 26,462	3/ 6,298,858

1/ Veracruz State Department of Agriculture estimate. Observations in the field indicate that 20 percent of the trees are not commercial.

2/ Veracruz State Department of Agriculture. This represents registered orange acreage for tax purposes and is therefore a very conservative figure.

3/ Trade sources and personal estimates from observations in the field. This is believed to be a conservative figure for 1951. Trade sources indicate that in recent years orange production has varied between 150,000 and 300,000 metric tons (4,724,000 and 9,448,000 boxes). An average production in recent years of about 225,000 metric tons (7,086,000 boxes) would seem reasonable according to informed trade sources.

Sources: 1939 and 1949-50: Boletín Mensual de la Dirección de Economía Rural, Secretaría de Agricultura y Ganadería; 1951: Veracruz Department of Agriculture and trade sources and personal observations.

Most of the present production comes from orange trees planted in coffee groves and consists primarily of early varieties of Corriente and Washington Navel. The new plantations are following a different pattern, and the Valencia is being planted in the younger groves. In the future, Veracruz will therefore produce a larger quantity of export-type oranges than in the past.

The potential orange production of this State is estimated at 10 million boxes per year.



The orange crop in the State of Veracruz will be larger in 1951 than in 1950 owing to an increase of about 25 percent in the Coatepec-Jalapa area where groves were favored by the season's heavy rainfall. The larger crop in this region will offset the loss in production from the Cordoba region where a prolonged drought reduced the crop to an estimated 25 percent of normal. Valencia oranges in the Cordoba region will be later this season than usual since an out-of-season bloom occurred when the first rains broke the drought in the spring. The estimated production of 6,300,000 boxes for the State in 1951 may be considered conservative, and new planting will probably increase production in the future.

Limes. Lime acreage and production have changed little in the past 10 years. Observations in the coastal area indicate that the planted area today is somewhat less than it was a few years ago; however, new acreage now being planted may increase production somewhat in the future. The trade estimate for 1951 of about 150,000 commercial trees and a production of 138,000 boxes seems reasonably accurate. While commercial lime production in Veracruz will probably continue, this State is likely to remain a minor lime area.

Table 24.--Limes: Number of trees, acreage, and production, Veracruz, 1939, 1949, and 1951

Source and year	Number of trees	Acreage	Production
	<u>Producing</u>	<u>Acres</u>	<u>Boxes</u>
Official 1939 . . .	125,000	1,950	98,435
Official 1949 . . .	170,000	2,800	199,103
	<u>Commercial</u>		
Trade 1951 . . . .	1/ 150,000	1/ 2,449	2/ 137,787

1/ Area registered by the Veracruz State Department of Agriculture.

2/ Trade and personal estimates.

Sources: 1939 and 1949-50: Boletin Mensual de la Direccion de Economia Rural, Secretaria de Agricultura y Ganaderia; 1951: State Department of Agriculture and trade and personal estimates.

Grapefruit. Both white and pigmented grapefruit are produced in the coastal lime area, but no data are available on the production or planted area. Production, which probably does not exceed 50,000 boxes at present, will be increased in the future as young groves come into bearing. The fruit sampled was of excellent quality.

## Climate

Climatic conditions vary greatly between the citrus producing areas in the State of Veracruz, principally because of differences in elevation. Climatic data for the cities of Veracruz, Cordoba, and Jalapa, the centers of the three most important producing areas, are given in table 25 for the period 1931-40.

The climate at Veracruz is indicative of the climate in the coastal plain where limes and grapefruit are raised. Irrigation is necessary only during January, February, and March, since at least an inch of rain falls in each of the other months. The humidity is high, averaging 85 percent, and in the period from 1931 to 1940 the temperature did not fall below 51.8° F.

The orange producing areas of Cordoba and Jalapa are at higher elevations and have a very different climate. Cordoba has the highest rainfall of the citrus areas. Here, rainfall averages over 85 inches per year, with rainfall in each month of the year and a maximum of over 18 inches in September. The humidity is lower than at Veracruz, averaging only 81 percent, and the maximum average temperature is over 100° F. in April and May. With the high rainfall in each month of the year, unirrigated citrus culture is entirely feasible. The damaging drought of 1950 was an unusual condition.

Jalapa, the major citrus producing area, has 60 inches of rainfall per year, 25 inches less than Cordoba. The humidity averages only 80 percent, and the maximum temperature does not exceed 93.56° F. on the average. The difference in climate is primarily due to the higher elevation at which the citrus areas at Jalapa are located. In Jalapa, as in Cordoba, the rainfall is distributed quite evenly throughout the year, and unirrigated citrus cultivation is possible.

The citrus producing areas of Veracruz are free from damaging frosts. The only climatic hazard experienced are the strong north winds that blow in the fall in the coastal plains.



Table 25. - Monthly data on climate at Veracruz, Cordoba, and Jalapa, 1931-40

City and month	Temperature			Relative humidity	Total rainfall	Days with frost
	Average	Maximum	Minimum			
	(° F.)	(° F.)	(° F.)	(Percent)	(Inches)	(Number)
Veracruz:						
January	71.42	86.36	51.80	87	.99	0
February	71.78	91.40	53.78	86	.64	0
March	73.22	92.66	54.50	86	.32	0
April	76.28	95.90	60.80	86	1.19	0
May	79.88	96.08	67.28	85	2.70	0
June	80.96	91.22	68.00	85	9.61	0
July	81.14	91.58	66.20	85	12.24	0
August	80.14	92.30	68.90	84	12.96	0
September	80.78	92.12	68.00	85	13.63	0
October	78.80	92.30	63.68	84	6.36	0
November	74.66	91.94	58.10	83	2.93	0
December	72.32	86.36	55.40	85	1.22	0
Annual	76.82	96.08	51.80	85	64.78	0
Cordoba:						
January	63.32	96.08	36.32	83	1.90	0
February	64.40	95.36	36.68	81	1.37	0
March	67.10	97.88	51.80	78	1.70	0
April	70.88	101.12	51.98	75	2.64	0
May	72.68	102.20	61.16	77	5.21	0
June	72.32	93.92	59.00	80	12.81	0
July	71.42	89.96	59.90	82	14.71	0
August	71.06	90.68	59.18	82	16.97	0
September	70.70	88.52	60.62	85	18.58	0
October	68.72	87.80	58.10	84	8.12	0
November	64.58	96.80	50.90	85	3.71	0
December	63.32	87.08	51.98	84	1.77	0
Annual	68.36	102.20	36.32	81	85.56	0
Jalapa:						
January	59.36	84.20	38.12	79	2.15	0
February	60.44	87.08	37.76	77	1.90	0
March	62.78	93.20	40.64	75	2.58	0
April	66.02	93.56	44.60	73	3.11	0
May	66.92	91.04	48.20	79	5.54	0
June	66.92	88.88	54.50	81	8.94	0
July	66.20	85.28	54.50	82	9.67	0
August	66.38	83.48	55.76	82	9.76	0
September	65.48	84.56	53.24	84	8.81	0
October	63.68	81.68	47.48	82	4.15	0
November	60.08	85.28	44.60	81	2.43	0
December	59.36	82.40	41.00	79	1.77	0
Annual	63.68	93.56	37.76	80	60.79	0

Source: Secretaria de Agricultura y Ganaderia, Servicio Meteorologico Mexicano. These data were obtained through kindness of Mr. Arnold P. Eliot, U. S. Weather Bureau Liaison Officer, American Embassy, Mexico, D. F.

## Cultural Practices

Size of groves. The commercial citrus industry of the State of Veracruz is based primarily on large privately-owned groves, most of which contain over 100 acres. However, groves range in size from 20 to several thousand acres. As a result of the land reform program, some citrus is raised on ejidos, but this is largely where big groves have been divided and the old citrus plantings are being maintained. There is little new citrus development on the small holdings.

Planting methods. In the coastal plain districts limes and grapefruit are planted about 25 feet by 25 feet. Some annual crops may be raised between the rows while the trees are young, but there is usually no permanent interplanting. In the foothill regions near Jalapa and Cordoba very different planting methods are followed. Inspection of the area indicates that probably only about 25 percent of the orange acreage is planted as a citrus orchard; the balance is a mixed planting with coffee, leguminous shade trees, and often bananas which are planted to shade the coffee rather than to provide a commercial crop. Where citrus is mixed with coffee the trees are usually planted 30 to 35 feet apart. Near Jalapa some new citrus orchards that were planted 5 or 6 years ago when citrus was high in price are being interplanted with coffee, which is now the most profitable crop.

Cultivation. Practices of cultivation differ greatly depending on the district and topography. In the coastal area where trees are planted at normal distances tractor-drawn disc harrows are used for cultivation; crawler tractors are used on the heavier soils.

In the higher orange districts of Jalapa and Cordoba cultivation practices depend largely on topography and nature of the planting. The orchards located on level ground and planted to oranges alone are cultivated with light wheel tractors and disc harrows. Most of the equipment seen here seemed too light for the soil type and the mats of weeds and grass. Where tractors are used, no cultivation is done during the rainy season in summer. Cultivation usually begins in October at the end of the heavy rains. Some of the orchards that could be cultivated are planted to permanent turf and operated without tillage. This is particularly true of the Fortin area where the turf is mowed to keep weeds and grass under control. Because of the very heavy rainfall and sloping nature of most of the orchards, permanent turf would seem to be an excellent practice to prevent erosion.

Hand cultivation is practiced in some of the newer terraced orange groves near Jalapa where the slopes are too great for mechanical cultivation; usually, a basin around each tree is the only area tilled.

The mixed plantings of citrus and coffee, which form the major part of the orange acreage in the hill regions of Cordoba and Jalapa, are tilled by hand with a short-handled, large hoe very similar to the one used in Italy and Spain. The coffee is cultivated at least once a year to a depth just sufficient to clear the weeds away. Most citrus is raised practically without cultivation.





General view of a large lime, grapefruit and mango ranch near Veracruz.



A young vigorous lime orchard near Veracruz.



Well-grown, balled lime trees. Note that the ball is wrapped in newspaper.



The Actopan River at Puente Nacional on the road from Veracruz to Jalapa illustrates the undeveloped water resources of the area.



The extensive young Valencia orange groves east of Jalapa.



A 5-year-old orange grove near Jalapa recently interplanted with coffee.



Terraced plantings of oranges near Jalapa.



An illustration of the relationship between coffee and oranges in much of the Jalapa-Coatepec-Cordoba region. The orange trees are on the right and left; a coffee plant and shade tree are in the center.



Some of the groves which have been tilled by hand, shows signs of erosion - main roots are exposed, and even a shallow hand-hoeing would cut many feeder roots. Groves in this condition were probably kept clean during the rainy season at some time in the past.

Pests and diseases. The major citrus pests and fungus diseases in the State of Veracruz are blackfly, purple scale, aphids, thrips, rust mite, sooty mold, melanose, gummosis, and psorosis.

Growers report that the rust mite is the most difficult pest to control. A rather heavy program of pest control is necessary to keep the trees and fruit clean. In the coastal area where limes and grapefruit are the primary crops, a well-operated grove requires one oil spraying a year, usually in the spring, and two applications of Bordeaux mixture and one of lime sulfur.

Characteristic of the pest control problems in the orange producing areas are those of a grove near Coatepec for which the following treatment is recommended by local growers.

1. From December to February aphids appear which may be controlled with nicotine sulfate.
2. In March another treatment is usually desirable for aphids and rust mites. A nicotine sulfate dust mixture can be used.
3. Starting April 15, an oil-Bordeaux-nicotine sulfate spray should be applied for scales, rust mites, aphids, exanthema, anthracnose, and brown rot.
4. In May a liquid lime sulfur spray should be applied for rust mites.
5. In July or August an oil spray should be applied for scale. 7/

In addition to the above-mentioned pests, a fruitfly also damages fruit from time to time. Although it is reported that the fruitfly is most active in the summer months, grapefruit infected with a fly was observed near Coatepec in October. The fruitfly is not considered serious in Mexico, but it probably could damage the United States citrus industry more than the blackfly.

Ants, which are active in many citrus groves and raise large hills under the trees, are controlled with carbon bisulfide. Growers believe that ants carry fungus diseases into the trees.

In recent years the blackfly has been the major citrus pest in Mexico. The State of Veracruz has carried out an intensive well-organized campaign that has been successful in bringing the pest under control in a most difficult situation where there are many host plants. A quarantine was established

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7/ This information was obtained through the kindness of Mr. Charles J. Duffy, Manager of the Mission Orange Company of Mexico at Coatepec.

against bringing fruit and plants into the State of Veracruz from other parts of Mexico. All motor traffic coming into the State is stopped and thoroughly inspected for infested material. The inspection stations use small spray machines to treat any suspect plants. The campaign to eliminate the blackfly began in January 1949, when the Governor of the State of Veracruz imposed special taxes to carry on a campaign against the pest. The tax was levied on coffee and on oranges (\$0.42 per short ton of oranges produced), and was collected and administered by the Agricultural Defense Committee. In addition, a tax of \$0.04 per gallon was levied on gasoline to help finance the program. The blackfly program at first cost the State of Veracruz an average of \$23,000 a month. By August 1951, blackfly control in Veracruz had cost \$750,000. Orange growers still pay a tax of \$0.21 per short ton on all oranges shipped to finance the program.

The program has been complicated by the fact that coffee and other crops are sometimes interplanted in the citrus groves and the oil sprays used to control the blackfly are injurious to these interplanted crops. In January 1951 a committee of growers from the Coatepec region asked that the quarantine be lifted for that region and the spraying stopped. At that time the growers believed that the fly had been controlled and that no further spraying was necessary. It was pointed out that the oil sprays would injure the set of the coffee plants by causing the buds to shed. However, spraying has been continued wherever necessary. Five sprayings are thought adequate in Veracruz to control the fly, but the quarantine will be maintained and spraying continued until there is evidence that the blackfly has been eliminated.

The success of the program is apparent in the citrus producing areas. No infestation of blackfly was seen, and no damage was apparent in the area.

Interest in pest control is a development of the last 10 years. The success of the blackfly program indicates what can be done when commercial necessity arises and will probably do much to increase the general interest in citrus pest control in Veracruz.

The two most serious diseases observed in the area are gummosis and psorosis. Gummosis is a serious problem because of the high rainfall. In spite of the use of sour orange rootstock and the frequent application of copper sulfate sprays, evidence of gummosis damage was seen in most groves. Gummosis was also seen on orange trees budded on rough lemon rootstock; in a young grove near Cordoba even the upper limbs had been attacked.

Psorosis is widespread and was observed on Corriente, navel, Jaffa, and Valencia varieties. As there is no program for certifying scion stock, this disease will probably be a serious problem in the future. One of the best orange groves in the Coatepec district is heavily infected with psorosis, and its producing potential will probably be affected.

Near Fortin a fungus was observed on dying orange limbs (See illustration page 65).

The treatment of both psorosis and gummosis is regular practice in the better operated groves. Usually the bark is scraped and then disinfected and sealed.





A fungus on dying limbs of orange near Fortin and Cordoba.



An ant hill in an orchard near Fortin. These pests are controlled by carbon bisulfide. This grove is operated by nontillage, using a permanent turf.



A mixed planting of high-pruned citrus trees typical of most of the Fortin district.



A high-pruned young orange grove with nontillage culture, near Fortin.



Right. A mixed planting of trees of different ages and varieties typical of the Fortin district.





A well-planted and operated full-bearing orange grove near Coatepec. A light tractor was being used to disc this grove in October. Note the pruning practice. This orchard contains about 45,000 trees, mostly navels, Valencias, and Jaffas.



A citrus nursery near Coatepec composed of wild seedling trees which will be used as rootstock. This land was cleared of sugarcane and is being planted to citrus and coffee.



Well-planted nursery of rough-lemon stock, near Cordoba.



A nursery near Cordoba with Valencia and navel orange trees on rough lemon stock.



Rootstocks. The major rootstock of both the coastal and hill regions is sour orange. In the coastal region limes were formerly grown from seed, but experimentation has shown that lime trees budded on sour orange stock grow faster and bear earlier, heavier crops than the seedling trees. As a result, progressive growers are planting only budded limes.

Rough lemon is being used as a rootstock for navel and Valencia orange trees by a grower near Cordoba. The trees are vigorous, but extensive gummosis activity has occurred. Many dying limbs were observed in a young orchard, and some trees only 6 years old had been killed. Thus, although rough lemon rootstock creates a fast-growing tree, it may not prove successful under Veracruz climatic conditions.

Near Jalapa where growers are planting oranges with coffee at least one large grower is obtaining wild citrus trees from the hills, or "Monte," for use as rootstock. This stock is of various ages and conditions and of uncertain origin and will probably prove to be a rather poor choice.

In all areas trees are balled for planting, and growers report that 4-foot budded trees are selling for \$0.29 each.

Irrigation. Irrigation is practiced in the citrus groves located on the coastal plain near Veracruz where a prolonged dry period occurs each year, usually beginning in October. The flood basin system is used, and water supplies seem to be abundant for this purpose.

The higher orange producing areas around Jalapa and Cordoba rely upon rainfall. In normal years there is sufficient moisture for citrus, but last year a severe drought occurred in the Cordoba region and caused a considerable drop of fruit. It is possible that in the future it may be found desirable to have some auxiliary irrigation equipment available, particularly for those orchards planted on light soils. Water could be developed in this region and applied by sprinklers even on groves planted on rolling land.

Irrigation projects are being developed to bring new land under irrigation in coastal plain areas suited to citrus. The present plans for irrigation are fairly extensive, but they cover only a small part of what is possible with the abundant water supplies available.

Fertilization. Fertilization practices vary widely in the citrus districts of Veracruz. In the coastal plain where citrus is not grown as a mixed planting commercial fertilizers are used together with green-manure crops. The orchards seen in the coastal plain were in excellent condition; the heavy foliage and good color indicated that a satisfactory fertilization program was used.

In the hill districts around Jalapa and Cordoba much of the citrus is planted with coffee. The leguminous shade trees in the mixed plantings add nitrogen to the soil, and their leaves afford a mulch. Ordinarily, very little fertilizer, if any, is applied to these groves. In 1951, however, the price of coffee was high, and some growers near Jalapa fertilized the groves with bat manure (guano de murcielago) obtained from caves near Puebla.

One grove seen near Cordoba was being fertilized with rotted garbage. The grower permitted the garbage to be dumped on his property, let it rot for some time, and then applied it to the grove. The trees were exceptionally vigorous, indicating that the garbage is a very rich source of nitrogen.

In the hill citrus districts the unmixed plantings of citrus usually receive a commercial mixed fertilizer, and according to the statements of growers the ordinary application supplies less than 1 pound of nitrogen per tree per year. Very few of the orchards appeared to be receiving sufficient fertilizer. Most of the trees were rather light leafed, and it was possible to see through them easily.

In the past, much of the nitrogenous fertilizer had to be imported; however, it is understood that a plant in Mexico is now producing sulfate of ammonia which is available to growers at a price of approximately \$31.49 per short ton.

Pruning. Pruning is practiced most extensively in the orange areas around Cordoba and Jalapa. At Fortin and Cordoba, where the groves show the heaviest pruning, the trees are pruned so that the first limb is often 6 feet from the ground. While it may be a desirable practice to raise the skirts of the trees in order to admit light and air and discourage gummosis, the pruning practiced seems excessive. High pruning is also practiced around Jalapa, but not to so great a degree as near Cordoba and Fortin. The trees in some of the larger groves seemed to be pruned in a satisfactory manner; the skirts were raised to about 3 feet and the trees were kept clean of deadwood, which is important from the standpoint of the health of the trees in this area where rainfall is over 50 inches per year.

On the coastal plain where limes and grapefruit are raised, pruning seems to be confined to the removal of deadwood and the trees seem to be in much the same condition as those in most commercial plantings in the United States.

### Varieties

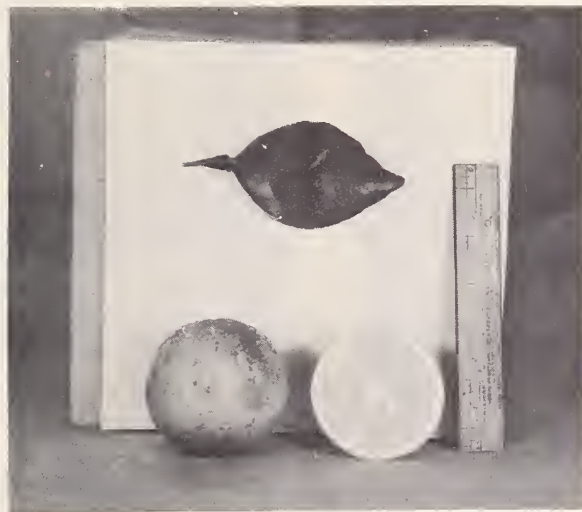
Older plantings of citrus, particularly oranges, in the State of Veracruz are of types unknown to United States growers. More recent plantings, however, have been confined primarily to known varieties. Most new plantings have been made to the Valencia, which bears well in the Veracruz noncoastal areas; a smaller acreage has been planted to the Washington Navel, which produces good quality fruit in most areas but bears very poorly in Veracruz. The erratic production of the Washington Navel seems to indicate that it is a poor variety for Veracruz districts.

The Washington Navel grows to very large size. Data collected by the Mission Orange Company of Coatepec indicate that, on the average, 100 Washington Navel oranges weigh 79-1/4 pounds, compared with 34-4/10 pounds per 100 for Jaffas, and 39-9/10 pounds per 100 fruits for Valencias.

In the State of Veracruz oranges bloom normally in December and January. However, owing to seasonal differences in rainfall, commercial blooms may occur at other times. This happened in 1951 in the Cordoba region when a bloom occurred in April after rains broke a prolonged drought.

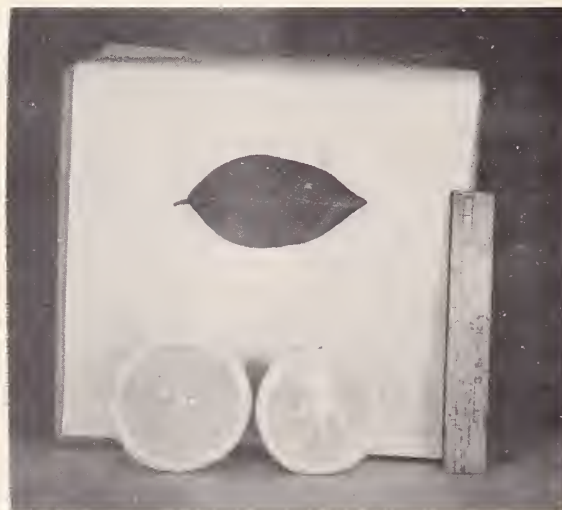


Representative samples of Veracruz citrus varieties were examined, and descriptions and photographs of the major commercial citrus varieties are given below.



Valencia

Valencia. In the Fortin, Cordoba, Jalapa, and Coatepec regions this variety produces good quality fruit of normal size. It appears to bear excellent crops when given proper care.

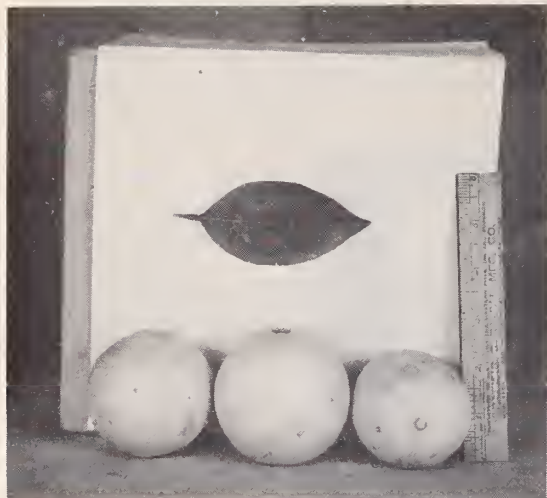


Jaffa (from Coatepec)

Jaffa (from Coatepec) - a nonblood seeded orange that matures slightly later than the Corriente and is picked November-January. On October 20, the interior of samples seen was colored and the peel breaking in color.

Samples examined had 9 to 10 sections and 6 to 15 seeds.

This fruit appears to be a different variety than the Shamouti orange of the Middle East which is often sold under the commercial name of Jaffa.



Corriente (from Coatepec)

Corriente (from Coatepec) - a group, not a variety. This is a non-blood seeded orange picked October-December. On October 15, the interior of samples seen was well colored and the peel was breaking in color to yellow. Trees grow upright and head high in shade; young growth is apt to have long thorns. Trees are vigorous, resistant to pests and disease, and bear regular crops averaging about 1,000 oranges per tree.

Samples examined were well flavored and juicy, and had 9 to 10 sections and 11 to 20 seeds. The fruit does not hold on the tree for long after it is mature.



Corriente, Cajela (of Fortin and Cordoba)

Corriente, Cajela (of Fortin and Cordoba) - a group. This is a non-blood seeded orange picked October-December. On October 15, the interior of samples examined was colored and the peel was breaking in color to full color. Samples examined had 10 sections and 21 seeds. This variety has a smooth peel and an excellent flavor. Growers report that it does not hold well on the tree. This variety produces well in this district.





Sugar Orange (of Fortin and Cordoba)

Sugar Orange (of Fortin and Cordoba) - a nonacid seeded nonblood orange picked October 15 to December. On October 15, the interior of fruit examined was colored but the peel was just breaking in color. Samples had 10 sections and 21 seeds.

Washington Navel. In Fortin, Cordoba, Jalapa, and Coatepec this variety is of good quality but tends to grow to large sizes. It is erratic in bearing habits in these districts, and in some years produces no fruit at all. It does not seem to be a good commercial variety for Veracruz.



Limes (Veracruz)

Limes (Veracruz) - small seeded fruit; thin skinned. Samples examined had 10 to 11 sections and 2 to 3 seeds.



White Grapefruit (from the coastal plain in Veracruz)

White Grapefruit (from the coastal plain of Veracruz) - a seeded white grapefruit. Samples examined contained 13 sections and 7 seeds. This is excellent quality fruit, and the trees produce large crops.



Pigmented Grapefruit (from the coastal plain of Veracruz)

Pigmented Grapefruit (from the coastal plain of Veracruz) - a medium-skinned, high-quality grapefruit; picked October 15 to December 15, could be exported in October. Fruit examined had 11 to 14 section; 3 to 7 seeds. This variety produces large crops, and the trees seen were vigorous.



The Corriente is still the most important orange in both the Cordoba-Fortin and Jalapa-Coatepec areas (see table 26). The Jaffa, which does not appear to be the same as the Shamouti variety sold under the same commercial name in the Middle East, is rather important in the Jalapa-Coatepec region where it is usually harvested after the Corriente is no longer available. The planting of the Washington Navel is no doubt encouraged by the fact that the return to growers from this type is at least twice the return from the seeded Corriente or the Jaffa. The nonacid sugar orange is important only in the Fortin-Cordoba area where growers are trying to develop a demand among consumers who cannot tolerate acid citrus fruits in their diet.

Table 26. - Utilization of estimated citrus area by age and type, State of Veracruz

Citrus area and type or variety	Season	Percentage of total citrus area	Percentage under 10 years of age
		Percent	Percent
Fortin-Cordoba area:			
Corriente . . . . .	Oct.-Feb.	35	10
Washington Navel . . . . .	Oct.-Dec.	20	25
Valencia . . . . .	Apr.-May	15	75
Sugar orange . . . . .	Nov.-Dec.	15	-
Grapefruit . . . . .	Dec.	5	-
Others (including sweet and sour lemons, limes and tangerines) . . . . .	-	10	-
Total . . . . .	-	100	-
Jalapa-Coatepec area:			
Corriente . . . . .	Oct.-Feb.	60.0	5
Washington Navel . . . . .	Oct.-Dec.	12.5	30
Valencia . . . . .	Apr.-May	12.5	80
Jaffa . . . . .	Dec.-Mar.	10.0	10
Others (including tange- rines, limes, and grape- fruit) . . . . .	-	5.0	-
Total . . . . .	-	100.0	-

Source: Trade sources and personal estimates from observations in the field.

The kind of citrus raised in Veracruz is further illustrated by the analysis of citrus juices in table 27. It will be noted from this table that the Jaffa is a somewhat less acid fruit than the Corriente and that it also gives a somewhat higher yield of juice. Both the Jaffa and the Corriente are used extensively for processing purposes; they are also consumed fresh in the domestic markets of Mexico.

The Corriente is planted extensively on coffee plantations where it is impossible to carry on a satisfactory pest control program, and the fruit is often of poor appearance due to damage by rust mite and other pests. Generally, the eating quality of the oranges raised in the Veracruz area is excellent, and the grapefruit raised on the coastal plain is of very high quality.

Table 27. - Analysis of citrus juices, by type and variety, average monthly values

Variety and month	Brix	Acid	Yield of juice
	Degrees	Percent (by weight)	Liters per metric ton
Corriente Orange:			
Oct. 1949 . . . . .	10.8	1.66	350
Nov. 1949 . . . . .	10.7	1.73	356
Dec. 1949 . . . . .	11.9	1.65	345
Jan. 1950 . . . . .	12.3	1.54	336
Dec. 1950 . . . . .	11.2	1.38	347
Jan. 1951 . . . . .	12.0	1.30	332
Feb. 1951 . . . . .	12.3	1.27	322
Jaffa Orange:			
Dec. 1948 . . . . .	11.8	1.40	375
Jan. 1949 . . . . .	11.5	1.40	356
Feb. 1949 . . . . .	10.5	1.00	379
Mar. 1949 . . . . .	10.8	.95	390
Lime (from coastal plain):			
July 1950 . . . . .	9.9	7.97	357
Aug. 1950 . . . . .	8.0	7.78	363
Sept. 1950 . . . . .	8.38	7.88	361
Grapefruit (from Jalapa):			
Jan. 1951 . . . . .	10.9	2.5	287
Feb. 1951 . . . . .	11.0	1.97	342

Source: These analyses were made by Mission Orange de Mexico, S. A., of Coatepec, Veracruz, and were obtained through the kindness of Mr. Charles J. Duffy, Manager.



### Some Economic Factors

Wages. The great agricultural expansion in the citrus areas of Veracruz is affecting the labor market, and wages are increasing. According to trade sources the average wage for unskilled agricultural labor in 1950 was \$0.58 per day. However, in 1951 there was a labor shortage and the average wage increased to \$0.69 per day. Since both coffee and citrus plantings are expanding and most of the area is tilled by hand, labor will probably continue to be in relatively short supply and wages will probably increase.

Cost of production. Because so much of the area is a mixed culture it is difficult to estimate the cost of citrus production. Trade sources estimate that the cost of operating an acre of hand-tilled oranges, including administrative costs, pest control, and fertilization, is about \$125.00. At a yield of 200 boxes per acre, which seems reasonable from observations in the field, the cost of production may be estimated at about \$0.58 per field box, or about \$16.43 per short ton, containing 31 boxes. These costs are for properly-cared-for groves containing citrus trees only; for this reason, they apply to not more than 25 percent of the citrus acreage because most citrus is raised as a mixed planting with coffee.

In the mixed plantings the costs of production are much lower. Little or no pest control is practiced, and tillage and fertilization may be considered primarily as costs of producing coffee, which is the main crop. The production cost for oranges grown with coffee is probably about \$0.19 per box.

Returns to growers. In the 1951-52 season Veracruz growers were receiving good returns on the sale of their fruit, and processors paid comparatively high prices. On the average, growers are reported to have received \$15.75 to \$21.00 per short ton for Corriente and Jaffa oranges, and \$31.50 per short ton for Valencias.

In the coastal plain, some growers are finding it profitable to raise grapefruit, including pigmented types. In 1950, growers are reported to have sold grapefruit for \$1.97 per box.

Growers report receiving \$3.78 per box for export limes and \$3.75 per box for limes sold for domestic consumption. The price of cull limes and orchard-run fruit was \$1.63 per box.

Transportation. In the past 10 years transport facilities, primarily highways, have been improved considerably. A paved all-weather road connects Jalapa with Mexico City and Veracruz, the principal markets. There is also an excellent road from Cordoba to Mexico City and Puebla, but the road from Cordoba to Veracruz is rough in parts. Most citrus from the Veracruz districts will probably continue to be shipped by truck to domestic markets as there is a general shortage of rail cars in Mexico and few refrigerator cars are available.

## Marketing

Most of the citrus produced in the State of Veracruz is consumed domestically. Some limes are exported to the United States by rail from near Veracruz. Only experimental export shipments of oranges have been made.

Picking. Oranges are pulled from the trees, a practice that often breaks the peel or fails to remove stems which later damage the fruit in transport. Much of the citrus in the coffee plantations is inaccessible to wheeled transport. The pickers have to carry the full boxes of fruit to an orchard roadway and thus perform much of the in-grove transport in addition to picking fruit. Often the labor of carrying the fruit to a roadway consumes more time than the picking. Growers state that picking oranges in coffee plantations is slow ladder work because of the heights of the seedling trees, some of which are 30 feet tall. In 1951, pickers in the Coatepec district were receiving \$0.12 per field box or crate holding about 70 pounds.

In the coastal area limes are pulled off the trees with a hook attached to a long pole. Some of this work is done by boys, who received \$0.46 a day for their work in 1951.

Packing. Limes from the coastal area are brought to the packinghouses where the fruit is graded and packed. The processing grade of fruit is composed primarily of the ripe yellow limes; the dark green fruits without blemishes are selected for export. In one packinghouse visited the fruit is brushed and waxed, but not washed. It is then calibrated in three sizes for export marketing, packed loose, and shipped to Nuevo Laredo for export sale.

Oranges sold on the domestic market are usually handled in bulk. It has been the experience of the operators of the modern orange packing plant at Coatepec that graded and sorted oranges bring no higher prices in the Mexico City market than ungraded fruit handled in bulk. A few specialty outlets, such as fancy fruit stores and hotels, will pay a premium price for graded oranges, but such markets are limited at the present time.

Domestic marketing. Fruit for the domestic market is usually purchased from the grower by the thousand (a "thousand" is equivalent to 1,000 standard-sized fruit; smaller fruit may be counted as 1,030 or 2,000 per thousand). Growers selling to fruit buyers, who are usually located in the Merced market in Mexico City, state that it is difficult to arrive at a definite contract even though the price per thousand is agreed upon. Arguments regarding size of fruit, etc., may result in many changes in conditions of sale before payment is received. Large growers in the State of Veracruz have their own sales outlets in the Merced and thus avoid this marketing difficulty. Because of the uncertainty of fresh fruit sales to fruit buyers, growers in Veracruz have been selling to the Mission Orange processing plant, which purchases fruit by weight.





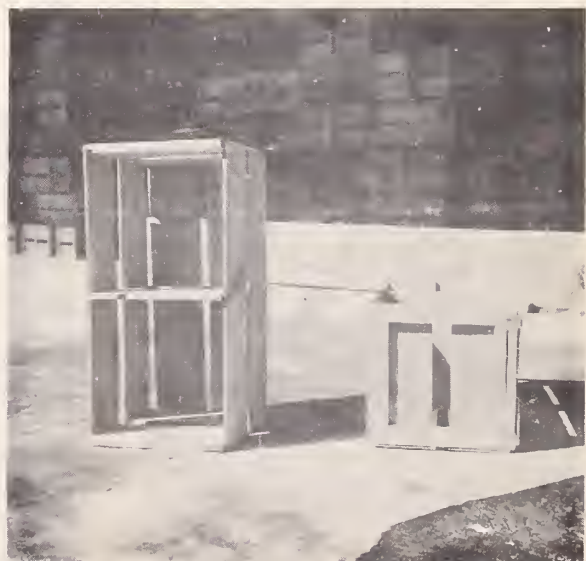
A vigorous 6-year-old Valencia orange tree grown on rough lemon rootstock (near Cordoba). Note the heavy crop.



A young grapefruit tree with a heavy crop of fruit (near Veracruz).



Orange packing machinery of American manufacture installed at Coatepec.



This Mexican-made box, used to export oranges from Coatepec, is a good container but was considered "too crude" by Belgian and Canadian customers.



A young lime picker near Veracruz is holding the 10-foot pole with hook used to pull the fruit from the tree.



A field box of limes near Veracruz. Pickers carry the fruit to the road.



A grading table in a lime packinghouse near Veracruz. Graders place nonexport-grade fruit in the center section as a conveyor belt carries the fruit by.



The bins which receive the export fruit after it has been graded, brushed, and sized into three sizes by this machine.



Export marketing. Experimental exports of oranges have been made to Canada and Europe. The two-compartment Mexican box used in the first shipment seemed to be an excellent container from the point of view of protecting the fruit, but purchasers in Canada and Belgium complained that the container was a poor merchandising package and stated that they preferred the California-type box.

It is difficult to export fresh fruit from Veracruz. For one thing, the port has no cold storage facilities. Ships taking on perishable cargo want to receive the whole shipment in one day, and growers must either store fruit at the dock without refrigeration or pack and transport an entire export shipment to the dock on the day the fruit is to be loaded. With the present limited packing facilities, this is impossible. Rail shipments are hampered by the shortage of refrigerator cars. In addition, export shippers are faced with an additional inconvenience in the port regulations which stipulate that only licensed trucks may haul shipments to dockside. The fruit must therefore be unloaded near the port and reloaded on trucks licensed to handle cargo to the docks.

Trade sources estimate that the cost of the fruit, packing costs, and transport total \$2.00 per 70-pound box f.o.b. Veracruz. In 1950 the sea freight from Veracruz to Belgium was \$2.10 per box. Rail freight rates are reported to be high. A 20-ton refrigerator car holding 520 boxes incurs rail charges of \$382.00 to Laredo and \$975 from Laredo to Montreal, Canada, including handling charges at Montreal.

The most significant factor in the outlook for exports is the new orange processing plant at Coatepec that can produce single-strength and concentrated juice products. Most of the factors that limit exports of fresh oranges - difficulty of handling fruit at the port of Veracruz, high rail freight rates, shortage of refrigerated rail cars, poor appearance of oranges grown with coffee - would have little or no effect on exports of processed citrus.

JALISCO

The State of Jalisco has a small, rather widely scattered citrus industry and produces excellent fruit for the domestic market. There is no processing in this area. Atotonilco, the only citrus district visited in Jalisco, produces two-thirds of the State's citrus; most of the other areas are of minor importance.

Table 28.--Estimated number of citrus trees,  
by type and district, Jalisco, 1951

District	Orange trees	Lime trees	Others (incl. grape- fruit, lime, orange, sweet lemon or lime)
	Number	Number	Number
Atotonilco . . .	240,000	20,000	40,000
Ayo El Chico . . .	50,000	--	--
Degollado . . . .	50,000	--	--
Tlaquepaque . . .	10,000	--	5,000
Tequila . . . . .	--	20,000	--
Sayula . . . . .	5,000	--	--
Cocula . . . . .	10,000	--	--
Ameca . . . . .	5,000	5,000	--
San Cristobal de la Barranca . . .	5,000	10,000	5,000
San Gabriel . . .	3,000	--	--
Tonila . . . . .	--	20,000	--
Amatitlan . . . .	--	20,000	--
Huascato . . . . .	20,000	--	--
Chihuahatlan . . .	--	50,000	--
Total . . . . .	398,000	145,000	50,000

-- None or negligible.

Source: Defensa Agricola.

Acreage and Production

The data in table 29 indicate that acreage and production of oranges have declined in the past decade. Actually, the citrus industry of Jalisco has increased. The acreage and production figures given in table 29 for 1939 and 1949 are believed to be about twice the actual figures for those years as the calculations were made on the basis of 64 trees per acre in 1939 and 61 trees per acre in 1949, whereas observations in the area indicate that at least 120 trees are planted to the acre. The 1951 trade estimates of a planted area of 3,000 acres and a maximum production of 472,000 boxes seem reasonable.



Table 29.--Oranges: Number of trees, acreage, and production, Jalisco, 1939, and 1949-51

Source and year	Number of trees	Acreage	Production
	Producing	Acres	Boxes
Official 1939 . . . .	285,000	4,453	501,673
Official 1949 . . . .	333,000	5,486	784,680
	All trees		
Trade 1951 . . . . .	1/ 300,000-500,000	2,965	472,414

1/ Estimated at 398,000 by Defensa Agrícola.

Source: 1939 and 1949-50, Boletín Mensual de la Dirección de Economía Rural, Secretaría de Agricultura y Ganadería; 1951 trade sources and personal observations.

The citrus industry is still expanding, and many new plantings may be seen south of Atotonilco for about 1 mile. The extent to which planting may be increased in the future is limited by the terrain, but the expansion will probably continue for some time. Growers indicate that 30,000 to 50,000 young trees are now being raised, and 3-foot budded trees are being sold for \$0.35 each. About half of the new plantings are sweet lemons; the balance is mostly Valencia oranges. Total production of oranges will probably not exceed 630,000 boxes per year in the near future.



Atotonilco, with orange groves in the foreground. The town is surrounded by citrus groves on the valley floor.



A terraced orange grove, Atotonilco.



Left. A navel orange grove at Atotonilco. Note the well-grown replant on the mound at the right.



Left. This young Valencia orange grove is typical of new plantings at Atotonilco.



A vigorous tangerine tree at Atotonilco.



A typical hand-cultivated citrus grove at Atotonilco.



## Climate

Atotonilco El Alto, which produces fine-quality oranges, has an average rainfall of 34.04 inches per year, but from November to April the rainfall is insufficient for citrus. The average temperature is 69.44° F., but an average maximum of over 100° F. is reached during 4 months of the year. Since Atotonilco is in a protected inland valley, surrounded by arid country, the average humidity is low.

Atotonilco was unharmed by the frost of 1950-51 that damaged the northeastern areas; however, frost damage is not unknown. Twenty-six days of frost were recorded in the period 1942-48.

Table 30.--Atotonilco El Alto, Jalisco: Monthly data on climate, 1942-48

Month	Temperature			Total rainfall	Days with frost
	Average	Maximum	Minimum		
	°F.	°F.	°F.	°F.	°F.
January . . . . .	63.32	94.10	37.40	0.48	3
February . . . . .	65.30	93.20	41.90	0.	3
March . . . . .	68.18	102.20	42.80	0.11	0
April . . . . .	71.78	98.60	44.60	0.36	0
May . . . . .	74.30	102.20	44.60	1.56	0
June . . . . .	75.20	100.40	46.40	8.56	0
July . . . . .	72.32	102.56	50.00	8.09	0
August . . . . .	71.78	93.20	53.60	7.01	0
September . . . . .	71.06	95.00	50.90	5.27	0
October . . . . .	72.32	92.30	47.30	1.13	1
November . . . . .	74.28	92.84	36.50	0.33	10
December . . . . .	63.68	95.90	36.50	0.36	9
Annual . . . . .	69.44	103.10	36.50	34.04	26

Source: Secretaria de Agricultura y Ganaderia, Servicio Meteorologico Mexicano. These data were obtained through the kindness of Mr. Arnold P. Eliot, U. S. Weather Bureau Liaison Officer, American Embassy, Mexico, D. F.

## Cultural Practices

Cultural practices are very similar to those of Spain and Italy, and nearly all orchards are cultivated by hand. Some of the groves on the side of the valley are terraced, and in many groves topsoil has been brought in from the adjacent areas in order to expand citrus plantings and to enrich

older citrus orchards. Goat manure is used extensively as fertilizer, and all the groves are irrigated about once a month during the dry season from October to May. In orchards visited irrigation water was applied by means of permanent basins which enclosed one or more trees, depending on terrain. The orchards seen were well cultivated, and the trees were pruned free of deadwood.

Rootstock. In the past 10 years the type of rootstock used has changed. When Motz and Mallory made their study in 1942, growers were beginning to use grapefruit rootstock in preference to sour orange rootstock, which has a dwarfing effect on trees in this district. The preference for grapefruit rootstock has been maintained, and nearly all commercial groves are now budded on grapefruit root, which seems to produce a vigorous tree in this area.

Pests and diseases. The most serious pest in Jalisco is the blackfly. Some scales were observed, but little or no pest control is practiced. The parasites and predators of the blackfly that have been introduced into the district were observed in infested orchards. Growers were encouraged by the apparent beneficial effect of the parasites introduced but feel that the success of this method of control is still to be proven. Despite a heavy infestation of the blackfly in orchards visited, the trees were producing commercial crops of fruit. Tangerines appeared to be less heavily infested than oranges. In this district it has been observed that the cooler winter weather reduces the fly population. Even though little pest control is practiced in the area, there is only a very light infestation of the Mexican fruitfly.

The most serious disease in the area is gummosis, and some psorosis was also observed primarily on Washington Navel orange trees. Older orange groves had some chlorotic leaves with patterns typical of zinc deficiency.

#### Some Economic Factors

Returns to growers. Fruit produced at Atotonilco is marketed primarily in Jalisco and the neighboring States of Guanajuato and Zacatecas. The 1950-51 freeze which damaged citrus in Nuevo Leon resulted in increased prices to growers at Atotonilco and stimulated new plantings. In 1951 growers were reported to be receiving about \$2.31 to \$2.78 per box of 200.

Cost of operation. In this hand-cultivated area, the cost of grove operation is comparatively high; in 1951 the cost of operating an orange grove was estimated at from \$37.46 to \$46.83 per acre. Since about 300 trees are planted to the hectare (121 trees to the acre), and each tree bears an average of 250 to 300 fruits the cost of operation may be estimated to be about \$0.35 per box of 250 to 300 fruits.



## Varieties

In new orchards the sweet lemon is being heavily planted as is the Valencia orange. Producing acreage is predominately early and midseason orange varieties, and the Escalon is the most important type. The quality of fruit produced is generally excellent. The tangerines are the finest the writer has observed outside the Mediterranean area.

Growers estimate that bearing acreage is divided approximately as follows:

	<u>Percentage of producing acreage</u>
Corriente . . . . .	25
Escalon . . . . .	35
Washington Navel . . . . .	15
Valencia . . . . .	10
Sweet lemon . . . . .	5
Sour, or bitter, orange . . . .	5
Tangerines . . . . .	5

Descriptions and photographs of the varieties grown in this area are given below.



Corriente (Atotonilco)

Corriente (Atotonilco) - a group of nonblood, seeded, early juice oranges with a smooth peel and slightly elongated shape. Samples examined in early November were juicy and well flavored with a highly colored interior; the peel was bright yellow to nearly full color. Fruit examined contained 9 to 11 sections and 13 to 18 seeds. These samples were grown on trees budded on grapefruit rootstock.



Washington Navel

Washington Navel. The Washington Navel grown at Atotonilco is a rather large, smooth-skinned fruit of excellent quality and flavor. In early November the interior of fruits examined was well colored, and the peel was breaking in color. Mature fruits in this area reach high color. These samples were grown on trees budded on grapefruit rootstock.

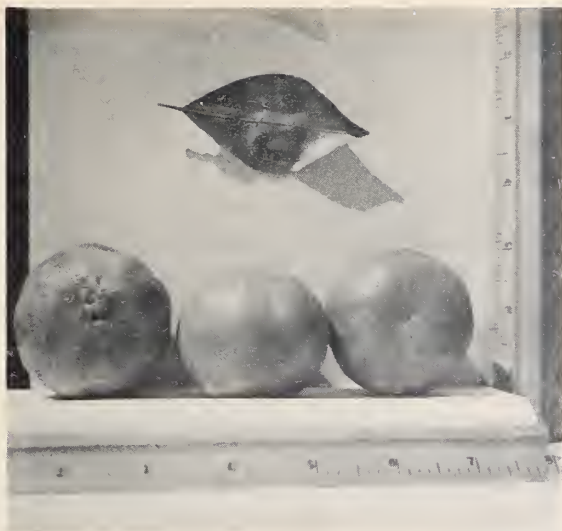


Escalon

Escalon. This nonblood seeded orange is the most important type raised in the Atotonilco district. It is a midseason, elongated, very smooth-skinned fruit. Samples examined in early November had well-colored interiors, but the peel was still dark green. The fruit had 8 to 9 sections and 9 to 13 seeds. Many of the fruits have a flattened area around the stem. The trees bear well and have an upright pattern of growth. The Escalon resembles the Shamouti of Israel but has more seeds and a smoother peel. Growers at Atotonilco stated that they believe this fruit was introduced from Palestine. The Escalon is raised on grapefruit rootstock in Mexico; the Shamouti is raised on sweet lime rootstock in the Middle East.







Mandarina Roja

Mandarina Roja - a tangerine of excellent quality equal to the best produced in the Mediterranean area. The trees bear well and have a rather large leaf for this type. Fruit examined in early November was ripe, had a highly colored interior, peel breaking in color, and 9 to 10 sections and 10 to 12 seeds. These fruits were grown on trees budded on grapefruit rootstock.



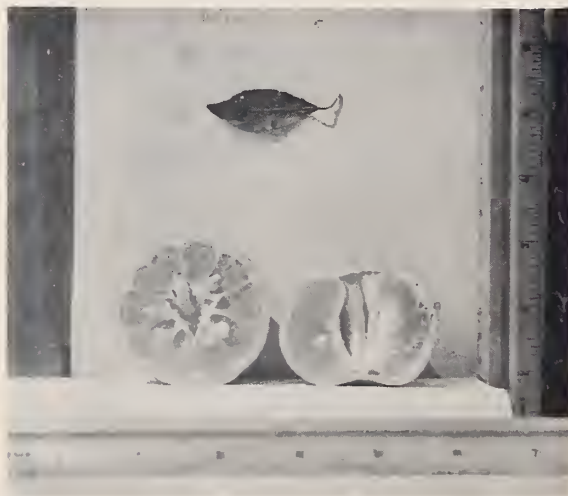
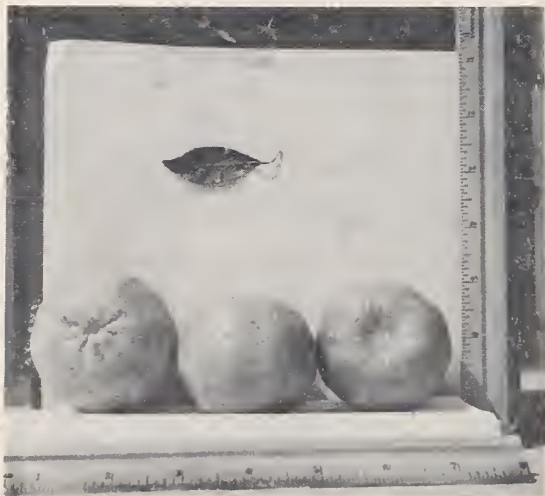
Sweet Lemon

Sweet Lemon. This variety, which is rather important in the Atotonilco district, is a rather small, green, fruit with a smooth, thin skin and almost no acid. Fruits examined had 9 sections and 12 seeds. These fruits were grown on trees budded on grapefruit rootstock.



**Tangerine**

Tangerine. The tangerine raised at Atotonilco is a medium-sized, thin-peeled fruit containing 12 sections and 14 seeds. Samples examined in early November were immature; the interior was highly colored, but the peel was still green. When mature, this is excellent-quality fruit. These fruits were grown on trees budded on grapefruit rootstock.



**Mandarin**

Mandarin. The tangerine known in Mexico as a "mandarine" is a large fruit when mature. The peel is not as smooth as the fruit called "tangerine" and it has a slightly earlier season. Fruit examined in early November was of good flavor and highly colored in the interior with the peel yellow to breaking in color. The seeds were almost round and quite large for a tangerine. Fruits contained 10 sections and 20 seeds. These fruits were grown on trees budded on grapefruit rootstock.



## SAN LUIS POTOSI

San Luis Potosi has become increasingly important in the past 10 years as an orange producing area, primarily through the growth of citrus districts along the Pan American Highway near Valles. The production of limes, however, is of even less importance than it was in 1939 and will probably remain at a low level since most of the lime groves near Valles have been removed in the past 3 years. Although the quality of some of the oranges grown is excellent and production is increasing, it is unlikely that any fruit will be exported from this State.

### Number of trees and Production

Most of the citrus trees are located in the Rio Verde and Valles districts, as can be seen from the following tabulation of the number of orange trees in the State in 1951:

<u>Municipal district</u>	<u>Number of orange trees</u>
Rio Verde . . . . .	334,929
Lagunillas . . . . .	28,201
Tamazunchale . . . . .	20,285
Villa Terrazas . . . . .	9,845
Valles . . . . .	226,742
Cd. del Maiz . . . . .	20,148
Tampacan . . . . .	13,650
Cd. Santos . . . . .	11,752
Tamuin . . . . .	46,946
Aquismon . . . . .	43,540
Tanlajas . . . . .	4,130
	<u>760,168</u>

The above figures should be considered conservative since they represent the number of trees on which the Regional Committee for the Control of the Blackfly collected taxes. Some trade sources estimate that Rio Verde alone has between 600,000 and 700,000 orange trees.

Data on number of orange and lime trees, acreage, and production are given in tables 31 and 32 for the years 1939, 1949, and 1951.

The acreage in the Rio Verde Valley has been comparatively stable. In the Valles area, however, about 200,000 citrus trees have been removed since 1949. Some of the trees were destroyed by the blackfly and by the 1951 flood, some were removed because of lack of facilities or water for irrigation during the drought in 1949 and 1950, and others were replaced with sugarcane and cotton which growers thought would be more profitable since citrus prices have been low in recent years and the crop uncertain. Plantings in a new grove on the road from Valles to Tampico about 10 miles east of Balles will partially replace the trees removed. In November 1951

this grove contained an estimated 60,000 trees, mostly Valencias, no more than 3 years old. If plans are carried out for the planting of an additional 40,000 trees in the next 2 years, this one grove will replace approximately half of the trees removed since 1949.

Because of the removal of groves in the Valles area, the State as a whole had fewer lime trees in 1951 than in 1939. The total number of orange trees was less in 1951 than in 1949, although this is not indicated in table 31. The official data for 1949 list 369,000 producing trees — probably only about half the number that existed at that time. The total number of orange trees in San Luis Potosi was probably about 1 million in 1949, compared to an estimated 760,168 in 1951.

Production of both oranges and limes has been substantially reduced in recent years by damage from frost, blackfly infestation, drought, and flood. In the Rio Verde district the frost of January and February 1951 reduced the crop to about 30 percent of normal, the losses ranging from 5 percent of the tangerine crop to 70 percent of the Valencia orange crop. In the Valles area crops were first reduced by drought and the blackfly, and later by flood. Trade sources report that total citrus production in the Valles area was not over 10,000 boxes in 1950. Despite the flood that put some groves under 5 to 10 feet of water for nearly a week in August 1951 and killed several thousand trees, it is estimated that the Valles area produced 100,000 boxes of oranges in the 1951-52 season. The area received more rain in this season and some growers were using oil sprays to control the blackfly.

Table 31.—Oranges: Number of trees, acreage and production, San Luis Potosi, 1939, 1949, and 1951

Source and year	Number of trees	Acreage	Production
	Producing		Boxes
Official 1939 . . . . .	271,000	4,233	39,681
Official 1949 . . . . .	369,000	6,086	1,021,895
	All trees		
Trade 1951 . . . . .	1/ 760,168	12,521	315,000

1/ This represents the number of trees on which taxes have been collected and is therefore a conservative figure.

Source: 1939 and 1949, Boletín Mensual Dirección de Economía Rural, Secretaría de Agricultura y Ganadería; 1951, Regional Committee for the Control of the Blackfly at Valles.



Table 32.--Limes: Number of trees, acreage and production, San Luis Potosi, 1939, 1949, and 1951

Source and year	Number	Acreage	Production
	of trees		
	Producing	Acres	Boxes
Official 1939 . . . . .	38,000	588	32,000
Official 1949 . . . . .	89,000	1,468	80,000
	All trees		
Trade 1951 1/ . . . . .	20,000	329	13,800

1/ Practically all present production is in the coastal area. The removal of groves at Valles makes this a permanent decrease in production.

Source: 1939 and 1949, Boletín de la Dirección de Economía Rural, Secretaría de Agricultura y Ganadería; 1951, trade sources and personal estimates.

Lime production is not expected to increase much beyond the 1951 estimate of 15,800 boxes because of the removal of groves in the Valles area. The 1951 estimate is based on production in the coastal district which will be the source of future production.

The production of oranges is expected to increase in the next few years. Growers in the Rio Verde area state that by the 1952-53 season the trees should have recovered sufficiently to produce a normal crop. By the 1953-54 season production of oranges in San Luis Potosi may reach 1,260,000 boxes, about 4 times the estimate for 1951-52. This is a somewhat lower production than might be expected from the existing planted area, but the Valles district is infested with the blackfly and has a considerable acreage of citrus planted on unirrigated land which will probably not be very productive.

### Climate

The climatic conditions in Rio Verde, the most important citrus area in San Luis Potosi are indicated in table 33. This is an inland protected citrus area surrounded by arid country and characterized by low relative humidity and a great range between minimum and maximum temperatures. As Rio Verde has a comparatively low rainfall of 19.77 inches per year and a dry period of 6 months from November to April when rainfall averages less than 1 inch per month, citrus can be produced only by irrigation in this district. This area is subject to damaging frosts about every 10 years.

The climatic data in table 33 are indicative of the Rio Verde region only. The Valles district is a coastal area with a much more humid tropical climate.

Table 33.--Rio Verde, San Luis Potosi: Monthly Climate 1931-1940

Month	Temperature			Relative humidity	Total rainfall	Days with frost
	Average	Maximum	Minimum			
	°F.	°F.	°F.	Percent	Inches	Number
January . . . . .	61.70	93.02	26.60	68	0.65	1
February . . . . .	64.22	95.54	30.56	67	0.17	1
March . . . . .	68.18	102.56	29.30	60	0.39	1
April . . . . .	72.68	104.72	37.40	59	0.77	0
May . . . . .	75.74	104.90	54.32	66	2.52	0
June . . . . .	76.10	101.66	54.50	66	2.23	0
July . . . . .	74.66	96.44	57.38	72	3.57	0
August . . . . .	74.48	95.72	56.30	71	3.04	0
September . . . . .	72.32	93.38	49.64	76	4.51	0
October . . . . .	69.26	91.40	41.36	74	1.04	0
November . . . . .	64.04	91.94	32.00	73	0.53	2
December . . . . .	63.86	88.70	33.80	71	0.33	1
Annual . . . . .	69.26	104.90	26.60	69	19.77	6

Source: Secretaria de Agricultura y Ganaderia, Servicio Meteorologico Mexicano.

### Varieties

The orange areas are of two types: the commercial orchards of propagated trees and the orchards of seedling trees. The commercial orchards include the majority of the acreage — at least 600,000 of the estimated 760,000 trees, or practically all of the Rio Verde, Valles, and Aquismon districts. The other districts produce primarily seedling Corriente oranges from mixed plantings.

In the commercial groves the Valencia is the most important variety, although the degree of importance varies somewhat between districts. Estimates in the Valles and Rio Verde districts indicate that the planted area is divided approximately as follows:

Valles district:	Percent of planted area
Valencias . . . . .	85
Navels . . . . .	5
Miscellaneous (including limes, grapefruit, tangerines) . . . . .	10
Rio Verde district:	
Valencias . . . . .	60
Tangerines . . . . .	15
San Miguel . . . . .	10
Criolla (thin-skinned, seeded orange harvested Nov.-Dec.) . . . . .	10
Washington Navel and other types . . . . .	5





A view of citrus groves south of Valles, San Luis Potosi.



A sprinkler irrigation system in a grove near Valles.



The area in the foreground now planted to cotton was a citrus grove until 1949 (Valles).



Right. A young grove of oranges east of Valles. This grove contained about 60,000 trees in 1951.



An orange tree with stunted foliage typical of blackfly damage (Valles).



Near Valles many trees have died in the past few years. The cause may be a disease or a subsoil condition; it is not quick decline.



A USDA Bureau of Entomology and Plant Quarantine crew doing experimental spraying for blackfly control (near Valles).



Lime packing equipment installed at Valles, but has not been used.



## Citrus Districts and Fruit Quality

There is a wide difference in the quality of oranges grown in San Luis Potosi. The warm, humid coastal area along the highway near Valles cannot produce the highly colored, fine-flavored fruit characteristic of the higher and less humid Rio Verde district. The mature navel oranges seen in the Valles area in mid-November were large and had fairly colored interiors, but the peel was only breaking into color and the fruit was insipid and rather dry. The Valencias produced in the coastal area are of better quality, but this variety is said to lack high flavor and color in February when mature.

The seedling Corriente oranges raised in the higher mountain valley districts, such as Tamazunchale, were yellow and nearly mature in mid-November.

## Cultural Practices

All commercially propagated citrus orchards in San Luis Potosi are cultivated with tractors at least twice a year. In the better-cared-for groves, the deadwood is pruned out and the skirts of the trees are raised to about 3 feet above the ground. Where pruning is a part of the cultural practice, pruning cuts are painted with a "tree seal" or wax.

Nearly all trees are budded on sour orange rootstock, and nursery trees are generally well grown.

Pests and pest control. The most important citrus pests in San Luis Potosi are scales (primarily California red scale in the Valles area), a leaf cutting ant, aphids, some rust mite, and the blackfly. In the Valles area it has been found that the rust mite and aphid are held under control by predators and parasites and that the use of DDT reduces the population of the beneficial insects and is apt to be followed by an infestation of rust mite and aphid.

The blackfly has been the major pest in the Valles area since 1948. The first infestation was so serious that many groves were either killed or so reduced in production that growers removed the trees in order to plant cotton. In 1951 the growers were replacing cotton with sugarcane, which is a profitable crop at Valles.

A committee formed to combat the blackfly collects 10 centavos per tree for control work in San Luis Potosi, Tamaulipas, and Nuevo Leon. It is reported that the committee has paid growers from \$0.35 to \$1.15 per tree for trees that had to be removed. In some cases where the trees were removed with equipment and labor employed by the committee the grower was charged for these services.

For several years the U. S. Department of Agriculture Bureau of Entomology and Plant Quarantine has been conducting experiments near Valles and at Guaymas on the west coast of Mexico to determine the effectiveness of commercial sprays in controlling the blackfly. Both conventional rigs and speed sprayers have been used.

These experiments indicate that oil-spray control of the blackfly is commercially feasible. One grove being sprayed in late November 1951 with a 1-percent oil and rotenone spray was only lightly infested with blackfly although the grove had not been sprayed for nearly a year. The blackfly has been a serious pest only in districts where spraying is not a part of citrus cultural practice.

Irrigation. Practically all of the citrus in the Rio Verde district and the majority of the commercial orchards within the Valles area are irrigated. San Luis Potosi, however, has a considerable acreage of unirrigated land, primarily in the more mountainous region south of Valles. The effects of irrigation were evident in a grove about 10 miles south of Valles, where only part of the grove had been under irrigation. The orange trees in the irrigated section had heavy foliage and produced a crop of at least 5 boxes per tree. The unirrigated section of the grove had hardly any crop, and what fruit there was came primarily from an out-of-season bloom that occurred after the drought was broken. From observations in the Valles area it would seem that only irrigated groves could be considered as commercial.

In areas where irrigation is practiced, the flood basin method is the most common method of applying water; however, a few growers use portable sprinkler systems. There are large undeveloped water resources in the coastal area of the state, and many growers obtain their water supply by pumping from rivers adjacent to their groves.

#### Prices to Growers

In 1951 the frost caused citrus prices to increase rapidly. Although the Rio Verde district was damaged by the freeze of February 1951 and most of the remaining crop was destroyed, the Valles area escaped injury. The crop was small, but growers who had irrigated their groves and had fruit received high returns. In January, oranges were selling for \$0.69 to \$1.39 per box of 200 retail. After the frost, growers received \$2.08 to \$2.32 per box of 200 for fruit at the orchard. At this price, growers who had crops of 500 fruits per tree received a gross return of about \$5.75 per tree.

#### Marketing

The Valles area, being comparatively close to the border, used to supply small quantities of limes to the United States. The planted area has been so reduced by the removal of groves that this trade will not be resumed in the near future.

In 1948 and 1949 there was considerable interest in citrus, and a modern packing plant with equipment for washing, waxing, grading, and packing two carloads of fruit per day was installed near Valles. The plant has never been used, since it was installed just as the blackfly infestation was starting. All fruit is sold domestically in bulk, ungraded.

There are no indications at present that an export industry will develop. Because of the varieties and quality of fruit raised and the location of the citrus districts, San Luis Potosi will continue to be important only as a supplier of fruit for the domestic market. The Rio Verde area, which produces fine-quality oranges, is located in the interior and most of its production goes to San Luis Potosi and other interior towns. The Valles area is located closer to the United States but it produces poor quality fruit.



# TAMAULIPAS

The State of Tamaulipas has a growing citrus industry which is now producing oranges, as well as small quantities of limes, for export. Most of the export oranges come from the Guemes district, primarily from the commercial plantings near Carmen and Santa Engracia, and the export limes from Llera.

The production of oranges in Tamaulipas will be greater than that of San Luis Potosi, in spite of a smaller acreage, because most of the groves are irrigated and more favorably situated than those in the Valles region of San Luis Potosi. Production of oranges is expected to increase considerably, as over half the present acreage consists of trees under 10 years of age.

## Number of Trees and Production

Citrus acreage has increased greatly since 1939 when Tamaulipas had 71,000 orange trees and 13,000 lime trees in production. In 1950 the Regional Committee for the Control of the Blackfly collected taxes on a total of 673,960 citrus trees, mainly orange trees, and it is believed that Tamaulipas may actually have as many as 1 million or more citrus trees. Acreage is expected to increase even further when nursery trees are again available.

The principal producing areas are located near Hidalgo, Llera, and Guemes, as can be seen from the following tabulation of the number of citrus trees on which the committee collected taxes in each district in 1950.

<u>Municipal district</u>	<u>Number of citrus trees</u>
Tampico . . . . .	32,863
Gomez Farias . . . . .	17,949
Cd. Victoria . . . . .	37,483
Villagran . . . . .	33,721
Guemes . . . . .	160,420
Villa Mainero . . . . .	8,259
Padilla . . . . .	27,328
Xicotencatl . . . . .	1,514
Villa Gonzalez . . . . .	5,921
Cd. Mante . . . . .	39,674
Ocampo . . . . .	53,734
Llera . . . . .	135,876
Hidalgo . . . . .	119,218
Total . . . . .	673,960

Data on number of trees, acreage, and production are given in table 34 for oranges and in table 35 for limes. In these tables the official figures for 1939 and 1949 are compared with trade estimates for 1951. The official figures for limes are believed to be more accurate than those for oranges. Fewer changes have taken place in the lime industry, and the official records reflect the actual situation.

Table 34.--Oranges: Number of trees, acreage, and production, Tamaulipas, 1939, 1949, and 1951

Year	Number of trees	Acreage	Production
	Producing	Acres	Boxes
1939 . . . . .	71,000	1,112	161,723
1949 . . . . .	203,000	3,346	490,177
	All trees		
1951 . . . . .	<u>1/</u> 673,960	<u>1/</u> 11,102	<u>2/</u> 315,000

1/ This represents all citrus trees on which the Regional Committee for the Control of the Blackfly at Valles collected taxes in 1950, and should therefore be considered as a conservative figure.

2/ The 1951-52 crop was greatly reduced by frost damage.

Source: 1939 and 1949, Boletín Mensual de la Dirección de Economía Rural, Secretaría de Agricultura y Ganadería; 1951, trade estimates.

Table 35.--Limes: Number of trees, acreage, and production, Tamaulipas 1939, 1949, and 1951

Year	Number of trees	Acreage	Production
	Producing	Acres	Boxes
1939 . . . . .	13,000	203	10,750
1949 . . . . .	137,000	2,251	175,000
	All trees		
1951 . . . . .	150,000	2,471	<u>1/</u> 13,800

1/ The 1951-52 crop was greatly reduced by frost damage. The Llera district, where most of the commercial lime orchards are situated, produced very little fruit in this season. Most of the 1951-52 production came from the coastal area.

Source: 1939 and 1949, Boletín Mensual de la Dirección de Economía Rural, Secretaría de Agricultura y Ganadería; 1951, trade sources and personal estimates



Both orange and lime production suffered from frost damage in 1951. The limes at Llera were damaged by frost in February 1951, and a commercial crop will not be produced until the 1952-53 season. Lime production in 1951-52 will come primarily from the small coastal districts that supply local markets. In the future, total production of limes in Tamaulipas will probably be about 220,000 boxes in normal years.

The 1951-52 orange crop was also reduced by frost, but the damage in the Carmen area was not extensive and a normal crop should be produced in the 1952-53 season. The production potential of the State of Tamaulipas is estimated at about 825,000 boxes of oranges in the 1952-53 season and at about 1,375,000 boxes in the 1953-54 season when additional young trees will have come into bearing. These estimates should be considered conservative since they are based on the area on which taxes were collected.

### Climate

The climatic data given in table 36 for Ciudad Victoria may be considered as fairly indicative of the climate at Carmen and Santa Engracia. Rainfall averages 33 inches per year and is fairly well distributed. Even in the drier months (December to March) when irrigation is necessary, rainfall averages one-half inch per month.

The important citrus areas of Tamaulipas have a milder climate than that of Ciudad Victoria, but the average maximum temperature reaches 100° F. in all but 3 months of the year. The relatively low average humidity makes for considerable variation in temperature which produces well-colored citrus fruits. Some damage by frost may be expected at least every 10 years. In 1950-51 citrus areas near Victoria were damaged by frosts; in the Carmen area fruit was frozen, but the trees suffered little damage.

Table 36.--Cd. Victoria, Tamaulipas: Monthly data on climate, 1921-30

Month	Temperature			Relative humidity Percent	Total rainfall Inches	Days with frost Number
	Average	Maximum	Minimum			
	°F.	°F.	°F.			
January . . . . .	60.62	91.04	28.04	71	0.69	2
February . . . . .	65.12	102.56	29.48	69	0.99	1
March . . . . .	71.42	107.06	34.52	67	0.86	0
April . . . . .	77.36	104.72	43.52	64	1.41	0
May . . . . .	80.24	106.88	48.74	70	4.73	0
June . . . . .	81.86	104.00	54.86	68	5.11	0
July . . . . .	81.68	103.28	56.12	65	3.03	0
August . . . . .	82.94	101.66	60.80	61	1.82	0
September . . . . .	79.16	101.12	59.18	73	7.57	0
October . . . . .	73.40	102.38	49.82	74	4.36	0
November . . . . .	67.28	91.76	41.36	75	1.74	0
December . . . . .	60.62	89.96	27.50	74	0.69	2
Annual . . . . .	73.58	107.06	27.50	68	32.99	5

Source: Servicio Meteorológico Mexicano.

## Varieties

The varieties of oranges raised are primarily types known to United States citrus growers, and trade sources at Carmen estimate that about 60 percent of present acreage is planted to Valencias and about 30 percent to early oranges called "Lisas" which consist of Parson Brown, Hamlin, Pineapple, and San Miguel. The remaining 10 percent is composed of the Washington Navel and miscellaneous types.

## Cultural Practices

Cultural practices in the State are rather modern, particularly in the Carmen and Santa Engracia area where all the cultivation is by tractor. Adequate water is available for irrigation.

Pests and diseases. Gummosis is the most important disease and California and Florida red scale and rust mite are the most serious pests. This area has been fortunate insofar as pests are concerned. By the fall of 1951 the citrus blackfly had infested the Mante area, which is of minor importance, but the strict quarantine established by the Committee for the Control of the Blackfly and the continuing inspection and eradication of infestations have kept the blackfly out of the important citrus producing areas of Tamaulipas. U. S. Department of Agriculture inspectors aid in locating infestations and constantly inspect citrus at the border.

Growers have found that in most years a biological control of scales and rust mite is effective, and the application of pesticides is unnecessary. This was true in the 1950-51 season, and fruit harvested in November 1951 was exceptionally free of all pest damage. In years when biological control is not obtained it is necessary to dust for rust mite and spray for scale.

## Marketing

Citrus produced in Tamaulipas is marketed primarily as fresh fruit. However, a large citrus processing plant has been built at Llera which could use at least 100 tons of fruit per day for the production of single-strength and concentrated juice and dehydrated peel. Since the plant is not located near large producing areas it has been used very little to date and will probably be dismantled eventually.

As the new plantings of the past 10 years have come into bearing and production has increased, greater interest has been taken in exporting citrus fruits to the United States, Canada, and Europe, and a packinghouse has been established at Carmen to pack export fruit. The equipment includes a washer, waxer, and color-add equipment, as well as modern grading and calibrating tables and bins. A room is also available for the gas treatment of fruit just breaking into color in order that it may receive a uniform color in the color-add treatment. This room is also equipped for the sterilization of fruit to be exported to the United States, and the operators of the packinghouse state that they plan to install a recording thermograph in the near future in order to comply with the new U. S. Department of Agriculture regulations on the sterilization process.





A USDA entomology and plant quarantine crew checking citrus trees at Nuevo Laredo for possible infestation with blackfly.



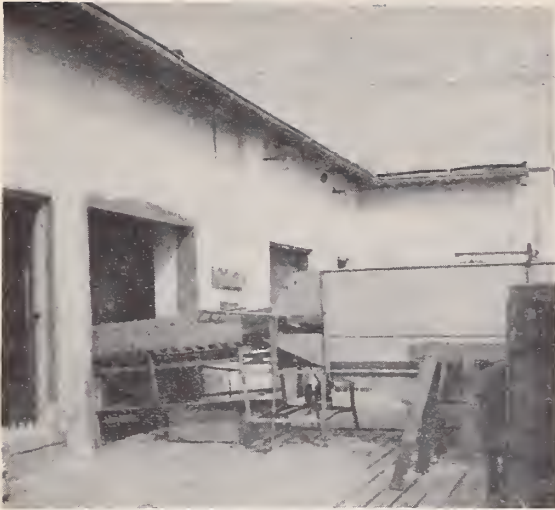
A fruit washer for export oranges at Carmen, Tamaulipas.



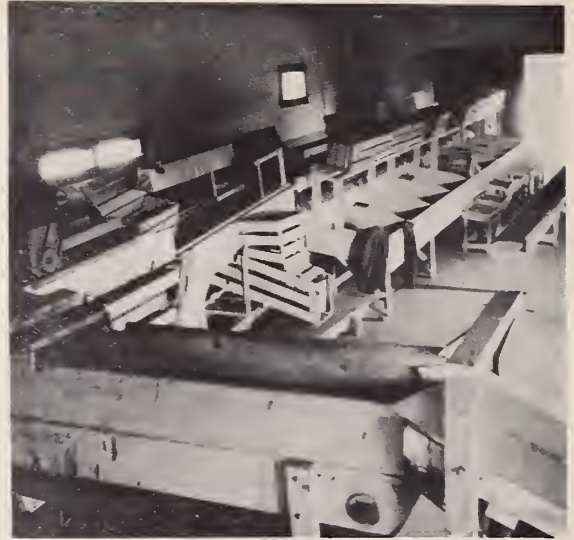
Circulating and venting fans installed over a sterilization room for export citrus at Carmen.



Color-add equipment for export oranges at Carmen, Tamaulipas.



A fruit washer at a citrus packing plant, Nuevo Laredo.



A small orange and grapefruit packing plant at Nuevo Laredo.

Right. A large orange and grapefruit packing plant at Nuevo Laredo. Note oranges packed in export Bruce boxes, and men holding export oranges in mesh bags.



Left. This large orange and grapefruit export packing plant at Nuevo Laredo has sterilization and color-add equipment.



The packinghouse at Carmen obtains its box shook from Durango. In 1950 shook cost \$0.40 per box. Because of price increases, boxes will cost approximately \$0.58 in 1952. When fruit is packed for export, packers are paid \$0.015 to \$0.02 per box. Export fruit is packed primarily in Bruce boxes made in Mexico, and it is shipped to the border by truck at a cost of from \$6.95 to \$9.25 per ton from Carmen to Brownsville, Texas. When fruit is sent to Europe, it is trucked directly from the packinghouse to shipside at Brownsville; when it is exported to Canada, it is trucked from Carmen to the border, where it is placed in refrigerator cars. It requires only about 5 hours for a loaded truck to go from Carmen to Reynosa or Brownsville.

Tamaulipas probably has the largest export packing capacity of any state in Mexico. Facilities for packing export oranges exist both in the producing areas and at the border. There is one packinghouse at Carmen and three at Nuevo Laredo. As production increases, it is possible that as much as one-third of the crop, or about 475,000 boxes, will be exported.



This packinghouse has a washer, waxer, four sterilization rooms, and color-add equipment. Packinghouses at Nuevo Laredo have facilities for exporting by rail.

## NUEVO LEON

The citrus industry of Nuevo Leon will continue to be the most important in Mexico. The industry has expanded greatly in the past 10 years; however, its commercial importance has not kept pace with the expansion in planted area. This is true for several reasons. Production is not as great as might be expected because much of the acreage is on unirrigated land that in recent years of drought has proved to be impractical for the production of commercial crops. In the Montemorelos area, much of which is excellent for the production of citrus, the full potential is not realized because growers do not maintain groves in the best condition. The marketing of fresh fruit is hampered by the fact that varieties have been mixed in commercial plantings to the extent that most important Lisa oranges are not a single variety, but a mixture of several varieties; for this reason it is impossible to establish uniform grades of fruit with uniform quality. In addition, the presence of the Mexican fruitfly in this area limits the sale of processed juice products.

### Citrus Districts

Most of the more important citrus areas in the States of Nuevo Leon lie on or near the Pan American highway (see map, page vi). The best areas seen were the irrigated sections near Linares, Hualahuises, Montemorelos, and General Teran. These districts have a sandy loam soil, which produces trees of good vigor and large production. Linares and General Teran are probably the best districts. In the fall of 1951 the orchards were recovering from the damage caused by the freeze of February 1951 and were not in a normal condition; however, the heavy foliage and vigor of growth indicated that this was an excellent citrus area.

The comparative importance of the citrus districts is shown in table 37, which indicates the number of bearing and nonbearing trees and the irrigated and unirrigated acreage in each municipal district of the State of Nuevo Leon. Montemorelos, with nearly 3 million trees, is the most important district. Other important districts are Linares, Allende, General Teran, and Cadereyta, which also produce export quality fruit. Some of the citrus acreage is not of commercial importance because of its location, lack of water, or damage from drought and cold.



Table 37.--Oranges: Number of trees and planted area,  
by municipal districts, Nuevo Leon, 1950

Municipal district	Number of orange trees			Area planted		
	In	Not in	Total	Irri-	Unirri-	Total
	production	production		gated	gated	
	Number	Number	Number	Acres	Acres	Acres
Montemorelos . . .	1,640,000	1,320,000	2,960,000	23,228	25,535	48,763
Linares . . . . .	530,280	420,420	950,700	12,355	3,306	15,661
Allende . . . . .	360,680	240,120	600,800	7,890	2,006	9,896
General Teran . . .	367,120	384,480	751,600	9,884	2,496	12,380
Villa Santiago . . .	165,200	150,300	315,500	5,197	0	5,197
Hualahuises . . . .	130,160	90,240	220,400	2,965	665	3,630
China . . . . .	41,959	12,540	54,499	907	0	907
General Bravo . . . .	7,486	4,380	11,866	195	0	195
Dr. Coss . . . . .	751	120	871	15	0	15
Aldamas . . . . .	1,107	171	1,278	20	0	20
Herrerias . . . . .	26,593	6,192	32,785	470	69	539
Cerralvo . . . . .	28,486	6,180	34,666	467	104	571
M. Ocampo . . . . .	642	0	642	10	0	10
General Trevino . . .	1,869	555	2,424	40	0	40
Aguaaleguas . . . .	1,969	180	2,149	35	0	35
Cadereyta . . . . .	669,227	280,992	950,219	12,849	2,802	15,651
Villa Juarez . . . .	6,100	3,600	9,700	124	37	161
V. Guadalupe . . . .	10,700	4,800	15,500	222	332	255
Monterrey . . . . .	5,740	2,760	8,500	99	42	141
Apodaca . . . . .	2,190	285	2,475	42	0	42
Dr. Gonzalez . . . .	2,700	2,800	5,500	74	0	74
P. Chica . . . . .	1,100	900	2,000	32	0	32
Abasolo . . . . .	100	0	100	2	0	2
Carmen . . . . .	125	0	125	2	0	2
Garcia . . . . .	130	0	130	2	0	2
V. Garcia . . . . .	300	0	300	5	0	5
General Escobedo . . .	200	0	200	5	0	5
General Zuazua . . .	175	0	175	2	0	2
Lampazos . . . . .	100	0	100	2	0	2
Ramones . . . . .	300	0	300	5	0	5
Marin . . . . .	150	0	150	2	0	2
Sabinas Hidalgo . . .	200	0	200	2	0	2
Salinas Victoria . . .	300	0	300	5	0	5
S. N. de los Garza . .	250	0	250	5	0	5
San Nicolas Hgo. . . .	200	0	200	5	0	5
Santa Catarina . . . .	1,045	0	1,045	15	0	15
Villaldama . . . . .	200	0	200	5	0	5
Total . . . . .	4,005,834	2,932,015	6,937,849	77,184	37,095	114,279

Source: Agencia General de Agricultura, Estado de Nuevo Leon.

# Number of trees

The State of Nuevo Leon estimate of 4,005,834 producing orange trees and 2,932,015 nonproducing trees in 1950 is corroborated by the fact that the Regional Committee for the Control of the Blackfly collected taxes on 4,364,683 citrus trees in Nuevo Leon in 1950. Committee officials stated that in their opinion they did not collect taxes on all planted acreage.

The changes that have taken place in the area planted to oranges in Nuevo Leon are indicated in table 38. Extensive new plantings have been made in Nuevo Leon in the past 10 years, and a comparison of the official estimate for 1949 (which may be somewhat understated) with the State of Nuevo Leon estimate for 1950 indicates that about 2 million trees may have come into production in 1950. The total number of producing trees should continue to increase rapidly as young groves recover from frost damage and come of bearing age. In 1951 trees were killed by frost in February, and no new planting could take place owing to the destruction of nursery stock by the freeze. It should be noted that the 1951 estimate in table 38 represents the number of trees believed to be in commercial condition. The way in which this estimate was arrived at is described in the following section on age and condition of orchards.

Table 38.--Oranges: Number of trees, acreage, and production, Nuevo Leon, 1939, 1949, 1950, and 1951

Source and year	Number of trees	Acreage	Production
	Producing	Acres	Boxes
Official 1939 . . . . .	420,000	6,565	784,586
Official 1949 . . . . .	1,882,000	31,018	5,165,063
State and trade 1950 . . . . .	1/ 4,005,834	65,988	
	Commercial		
	condition		
Trade 1951 . . . . .	2/ 4,782,610	2/ 77,138	2/ 692,874

1/ Does not include 2,932,015 nonbearing trees. In 1950 the Regional Committee for the Control of the Blackfly collected taxes on 4,364,683 citrus trees in the State of Nuevo Leon. Estimated on basis of 150 trees per hectare (61 per acre).

2/ Includes tangerines. Based on personal estimates -- see text on the condition of orchards.

Source: 1939 and 1949, Boletin Mensual de la Direccion de Economia Rural, Secretaria de Agricultura y Ganaderia; 1950, Agencia General de Agricultura, Estado de Nuevo Leon (see table 37); 1951, trade and personal estimates.



## Age and Condition of Orchards

In order to obtain data on which to base this evaluation of the citrus area the writer estimated and recorded the age and condition of all orchards seen from the highway in driving through the Montemorelos, General Teran, Allende and Cadereyta districts, and the data obtained is included in table 39. This route covered only a part of the state and only the part of the planted area seen from the road. Even with these limitations an estimated 1,490,940 trees were seen.

Age. An indication of the age of orange orchards is found in table 37 which lists 2,932,015 trees, or about 40 percent of the estimated total of 6,937,849 trees planted as not in production in 1950.

Observations in the area described above also indicate that a large percentage of the planted area is not yet in full bearing (see table 39). Most of the groves seen were young, and it is estimated that over 45 percent of the trees were less than 10 years of age. As these trees reach maturity, considerable increases in production should be expected from the area.

Condition. The condition of groves in Nuevo Leon varies greatly depending on location and the effect of drought and frost. Although irrigation is the most important factor influencing the condition of the groves, about 33 percent of the total estimated planted area, was not irrigated in 1950 (see table 37). Observations indicate that a large percentage of the unirrigated groves will never produce a commercial crop of fruit. Many unirrigated groves contain stunted, half-dead trees that do well to stay alive and occasionally produce some fruit in seasons of abundant rainfall. Some of the unirrigated groves on the slopes of large hills or mountains seem to receive sufficient moisture for commercial production from underground seepage, but about 25 percent of the present planted area must be considered as noncommercial because of an inadequate water supply.

The condition of the groves seen was tabulated; of the estimated 21,332 acres seen (containing about 1,490,940 trees), 779 acres, or 3.65 percent, were abandoned, an additional 2,222 acres, or 10.42 percent, were not in commercial condition, and 18,331 acres, or 85.93 percent, were in commercial condition. In this estimate a grove was considered abandoned when a large percentage of the trees had been killed and no care was being given the grove. A grove was considered as noncommercial when over one-third of the trees had been killed and the remaining trees were so damaged or stunted as to make it unlikely that commercial crops could be produced. Groves in the commercial category were those in such condition that they could produce commercial crops, and most of these groves were being given some cultural care. Most of the groves classed as noncommercial were unirrigated; many of these groves had been damaged by frost but far greater damage had been done by drought prior to the frost. Most of the groves classed as commercial were damaged to some extent by frost, the low areas of the groves being most heavily damaged. On the average the number of trees killed by frost in commercial groves did not exceed 10 percent.

Table 39.--Observed age and condition of citrus groves in Nuevo Leon on specified highway routes

Route of observation	Estimated planted area Acres	Estimated number of trees Number	Estimated age				Estimated condition			
			1-5 years	5-10 years	10-15 years	Over 15 years	Abandoned	Commercial	Not Commercial	Acres
Monterrey to Montemorelos via Allende . . . . .	6,215	435,050	2,080	1,245	1,855	1,035	380	1,305	4,530	
Montemorelos to General Teran . . . . .	7,260	508,200	630	1,275	2,970	2,385	30	200	7,030	
Road by river at Montemorelos . . . . .	1,820	127,400	250	410	600	560	110	0	1,710	
Monterrey to Cadereyta . . . . .	254	15,480	82	105	67	0	84	18	152	108
Cadereyta to Allende . . . . .	5,598	391,860	378	3,128	1,477	615	175	614	4,809	
Side road west near Allende . . . . .	185	12,950	0	115	60	10	0	85	100	
Total . . . . .	21,332	1,490,940	3,420	6,278	7,029	4,605	779	2,222	18,331	
Total as percent age of total planted area . . . . .			Percent: 16.03	Percent: 29.43	Percent: 32.95	Percent: 21.59	Percent: 3.65	Percent: 10.42	Percent: 85.93	

1/ Estimated at 70 trees to the acre.

Source: Estimates made by the writer.



To summarize the condition of Nuevo Leon citrus, about 25 percent of the groves are not commercial because of lack of water and about 10 percent of the remaining trees have been killed by frost. Therefore, of a total estimated planted area of 114,279 acres in 1950 about 25 percent, or 28,570 acres, are noncommercial because of lack of water. Of the remaining 85,709 acres, 10 percent, or 8,571 acres, were killed by frost, leaving a total estimated commercial acreage of 77,138 acres containing about 4,782,610 trees. This area may be considered to be in fair commercial condition in 1951.

The groves that were in good condition at the time of the frost suffered only temporary damage. Deadwood had not been removed from most frost-damaged groves in the fall of 1951, but the trees were rapidly recovering a normal foliage and should set nearly a normal crop in the 1952-53 season.

### Production

In the 10-year period 1940-49 citrus production increased greatly as newly planted acreage came into production (see table 38). Since 1949, however, production has been retarded by drought and frost.

Table 40 gives data collected by Defensa Agricola in the issuance of shipping permits on production of citrus in five important municipal districts in Nuevo Leon for the 1949-50 season. The estimates of the last three crops given in table 41 were arrived at by using Defensa Agricola data for these five districts and adding an estimated 20 percent to cover the production in the other citrus districts. These data are not comparable with the official data in table 38.

The 1950-51 and 1951-52 crops were greatly reduced because of frosts in 1949, 1950, and February 1951. The 1951-52 orange crop was estimated to be about 10 percent of normal, or about 630,000 boxes, the tangerine crop fared better and was about 50 percent of normal. The production of grapefruit is small; however, some was being exported to the United States in November 1951.

The small crop affected fruit quality, and the fruit is generally larger than normal with an unusually thick peel in the larger sizes.

If normal weather prevails in the next few years production may be expected to increase rapidly and by the 1953-54 season an orange crop of 7,900,000 boxes is possible. Considering that there are over 4 million trees in commercial condition, a moderate yield of only about 2 boxes per tree on the average would produce the indicated amount. Large acreages will average better than 5 boxes per tree in normal years, and a production of 10 boxes per tree is not unusual for tangerines.

Table 40.--Nuevo Leon: Citrus shipments from five districts, October 1949 to August 1950 1/

Variety	Montemorelos		General Teran		Allende		Villa de Santiago		Cadereyta		Total	
	Boxes		Boxes		Boxes		Boxes		Boxes		Boxes	
Oranges:												
Other than Navel:												
Domestic shipments	844,519											
Export shipments	452,983				560,032		46,895		170,667		1,702,644	
					60,752		4,504		6,236		556,788	
Total	1,297,502		112,844		620,784		51,399		176,903		2,259,432	
Navel:												
Domestic shipments	65,193		5,480		8,472		1,512		4,125		84,782	
Export shipments	1,638		378		0		0		378		2,394	
Total	66,831		5,858		8,472		1,512		4,503		87,176	
Total, oranges	1,364,333		118,702		629,256		52,910		181,407		2,346,608	
Tangerines:												
Domestic shipments	87,428		3,402		10,708		6,173		976		108,687	
Export shipments	17,290		1,606		8,661		0		0		27,557	
Total, tangerines	104,718		5,008		19,369		6,173		976		136,244	
Grapefruit:												
Domestic shipments	5,291		744		1,763		55		276		8,130	
Export shipments	5,925		193		0		0		0		6,117	
Total, grapefruit	11,216		937		1,763		55		276		14,247	

1/ These five municipal districts contain about 80 percent of the planted area.

2/ Includes Hamlin, San Miguel, Farson Brown, Pineapple, and Valencia Late.

Source: Defensa Agrícola. Date taken from shipping permits, obtained through the kindness of Mr. Teodoro Rodriguez.



Table 41.--Nuevo Leon: Estimated citrus production, by variety or type, 1949-50 to 1951-52 1/

Variety or type	1949-50	1950-51	1951-52 2/
	<u>Boxes</u>	<u>Boxes</u>	<u>Boxes</u>
Oranges:			
Other than Navel . . . . .	2,711,312	695,394	-
Navel . . . . .	104,687	61,918	-
Total oranges . . . . .	2,815,999	757,312	629,886
Tangerines . . . . .	163,518	25,290	62,988
Total oranges and tangerines . . . . .	2,979,517	782,602	692,874
Grapefruit . . . . .	17,113	5,622	13,779

1/ Based on data prepared by the Defensa Agrícola on shipments out of five important districts; 20 percent has been added to compensate for production in the other citrus areas in Nuevo Leon. These data are not comparable with the official figures in table 38.

2/ Preliminary estimate.

#### Climate

Climatic conditions in the citrus areas of Nuevo Leon differ considerably, as can be seen from the data on Montemorelos and Linares in table 42. Linares is in a more favorable situation than Montemorelos: It receives twice as much rain, and in only one month of the year does rainfall average less than 1 inch. At Montemorelos not only does rainfall average less than 1 inch in 8 months of the year, but, most important, it averages only 0.27 inch in July and 0.69 inch in August, two of the warmest months of the year, when the growing citrus crop has a high water requirement. Because of the erratic rainfall Montemorelos would appear to be a very hazardous region in which to attempt unirrigated citrus culture. Climatic conditions at Montemorelos are considerable different from those at Jalapa where unirrigated citrus culture is carried on successfully. Jalapa has an average rainfall of over 60 inches per year and over 1.6 inches of rain in every month of the year.

The citrus districts of Nuevo Leon have a high frost hazard, and groves were damaged in 1935, 1949, and 1950-51. The frequency of frosts will probably cause some areas now planted in citrus to be abandoned.

Table 42.--Nuevo Leon: Monthly data on climate  
at Linares and Montemorelos, 1931-40

Location and month	Temperature			Total rainfall	Days with frost
	Average	Maximum	Minimum		
	°F.	°F.	°F.	Inches	Number
Linares:					
January . . . . .	59.54	91.60	23.00	1.52	6
February . . . . .	62.78	99.50	29.84	.75	3
March . . . . .	66.92	102.74	32.18	1.07	2
April . . . . .	72.50	108.14	41.36	2.18	0
May . . . . .	76.46	104.00	53.78	3.22	0
June . . . . .	80.24	102.92	63.50	2.76	0
July . . . . .	80.42	102.56	64.94	4.73	0
August . . . . .	81.14	102.20	63.14	5.01	0
September . . . . .	77.00	101.12	57.20	7.26	0
October . . . . .	72.50	102.74	45.32	2.05	0
November . . . . .	63.68	91.94	32.36	1.13	3
December . . . . .	59.90	92.30	32.36	1.22	4
Annual . . . . .	71.06	108.14	23.00	32.92	18
Montemorelos:					
January . . . . .	59.90	89.24	32.90	.44	3
February . . . . .	62.96	91.76	33.08	.39	0
March . . . . .	75.38	101.84	33.26	.72	0
April . . . . .	78.26	102.56	33.08	.89	0
May . . . . .	82.94	109.04	54.14	3.29	0
June . . . . .	83.66	109.04	62.96	3.25	0
July . . . . .	87.26	106.88	65.48	.27	0
August . . . . .	85.82	105.08	64.76	.69	0
September . . . . .	82.04	101.84	53.78	2.52	0
October . . . . .	77.36	98.24	54.68	1.53	0
November . . . . .	68.36	94.64	41.00	.95	0
December . . . . .	59.54	86.18	33.08	.45	1
Annual . . . . .	75.20	109.04	32.90	15.40	4

Source: Secretaria de Agricultura y Ganaderia y Servicio Meteorologico Mexicano. These data were obtained through the kindness of Mr. Arnold P. Eliot, U. S. Weather Bureau Liaison Officer, American Embassy, Mexico, D. F.



## Cultural Practices

Cultivation. Practically all of the commercial groves in Nuevo Leon are cultivated by tractor; the exceptions are those planted on unirrigated land where terrain precludes the use of mechanical tillage. Johnson grass is a serious pest in orchards, and more frequent cultivation than would otherwise be required is necessary to control this noxious weed. General observations in the district indicate that cultivation practices are not so good as they should be for the best commercial operation. Many groves are not cultivated until the trees have been nearly smothered by weeds and vines.

Planting methods. In Nuevo Leon commercial citrus orchards have been budded on sour orange rootstock almost exclusively as a protection against gummosis. Generally, planting distances in the groves established in the past 15 years have been 30 feet by 30 feet, and in most groves the average number of trees is about 61 per acre. Although modern planting practices have been followed with respect to tree distances, most of the commercial orchards of Nuevo Leon are mixed plantings as to varieties. Since as many as four or five varieties may be found in a single orchard, it is difficult to obtain uniform packs. The practice of mixing varieties influences fruit quality early in the season because of differences in the maturity of the several varieties.

Irrigation. Most of the groves around Allende and in the Montemorelos valley are irrigated either by pumps or by gravity water. In some areas gravity water is available for irrigation once a month during the dry season. Many citrus groves, particularly those in the area between Allende and Monterrey and east of Allende toward Cadereyta, are planted on land that cannot be irrigated because of the steep slopes or because water is not available. Most of these unirrigated groves have suffered from drought, and the stunted condition of the trees will preclude their ever being considered as commercial. There seems little likelihood that irrigation water can be brought to this area to alleviate this condition.

The open wells seen in the Montemorelos citrus area indicate that supplies of water may be found at a depth of about 30 feet in most places. The electrification program planned for this district will make pumping feasible, and it will be possible to irrigate large tracts of additional land.

The Linares area possibly has a better water supply than Montemorelos, and it is planned to supplement the present supply by constructing a dam that will conserve water resources and bring large areas of land suitable for citrus under irrigation.

Pests and pest control. The most serious pests in the area are California and Florida red scale, oyster scale, rust mite, and the Mexican fruitfly. In some areas these pests are controlled by predators and parasites to such an extent that pest control is not necessary. In the fall of 1951, some California red scale was observed in orchards near Montemorelos, but most groves seen were quite free of pests.

In years when pest control is necessary sulfur dusts are applied in May and June for the rust mite, and a 1-percent solution of oil is applied in November and December for scales. Fruit, particularly the Lisa group, which is to be exported, is sprayed with oil in September in order to avoid spraying overripe fruit. No pest control operations are ever carried on in July when the hot, dry weather may cause trees to be injured. In the district as a whole, the commercial control of pests is apparently not difficult and pest control is not a serious part of cultural operations in most years.

A few outbreaks of the citrus blackfly have occurred in Nuevo Leon; however, the quick action of the Committee for the Control of the Blackfly in spraying the infested areas has eradicated this pest. The work of keeping the blackfly out of Nuevo Leon is continuing. A strict quarantine has been set up to prevent the entry of possibly infested host material into the state, and the orchards are constantly inspected in order that incipient infestations may be found and eradicated. The fact that the blackfly has not become established in Nuevo Leon is evidence of the effectiveness of this program.

The Mexican fruitfly is the most serious pest influencing fruit quality. It is this pest which makes necessary the sterilization of all Mexican citrus imported into the United States. An infestation of the fly may destroy all the fruit on a single tree, and considerable quantities of fruit are lost each year in the grove. Fruit stung by the fly is limited in keeping quality because of the larvae introduced into the fruit. The presence of larvae in most citrus from December on limits the utilization of Mexican oranges and grapefruit for processing purposes. It is probably impossible for any large quantity of fruit to be completely free of larvae. This factor will preclude the import of Mexican orange and grapefruit juice into the United States.

Diseases and disease control. The most serious citrus disease is gummosis, which damages trees during excessively wet weather, particularly those on heavy soils. Since there is no procedure for certifying scion stock, psorosis has become established on most commercial varieties in the area. Every grove visited, having trees more than 15 years old, showed evidence of some diseased trees. It appears from observation in the district that no attempts are made to treat the diseased trees other than to cut out any large areas of deadwood. The seriousness of this disease will probably not become apparent until existing orchards are somewhat older and the full effect of the infection is known.

Pruning. In normal years it seems to be a commercial practice to prune out deadwood and to raise the skirts of the trees about 2 feet. The extensive damage caused by drought and frost in the past 3 years has created a serious pruning problem in most groves. In the fall of 1951 deadwood had been removed in only a small percentage of damaged groves. If the removal of this deadwood is long delayed, diseases may gain hold and injure orchards that otherwise might have fully recovered from frost damage.





Well-grown tangerine tree with a good crop of fruit, at Linares.



A nursery of seedling sour orange trees near Linares.



Typical irrigated orange grove near Montemorelos.



Extensive irrigated orange groves near Montemorelos.



Young orange trees protected against frost by banks of earth, Montemorelos.





An outbreak of psorosis on an orange tree near Montemorelos.



A stunted orange tree typical of those on unirrigated land.



Young orange trees on unirrigated land damaged by drought and frost.



Groves near Allende on unirrigated land. Most of the groves are in fair condition.





This unpruned orange tree at Linares indicates the extent of frost damage.



The man at right is holding the frost-damaged wood pruned from this young orange tree at Linares.



Pull picking oranges near Montemorelos.



Oranges are dumped into an oxcart (left) for transport out of the grove. The oxcarts are emptied at the edge of the grove and the fruit is counted (above). Then the fruit is loaded on trucks for shipment to market in bulk or to packinghouses for export.



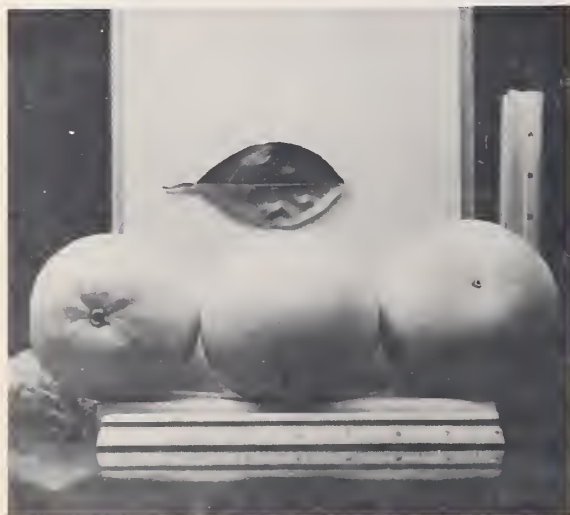
## Varieties

Most of the varieties of oranges raised in Nuevo Leon are known types, and growers divide them for commercial purposes into Washington Navels, Lisas (a group comprising several varieties, principally Hamlin, Pineapple, Parson Brown, and San Miguel), the Mediterranean Sweet produced as a mid-season orange to be harvested after the Lisa, and the Valencia. The Mediterranean Sweet is a midseason fruit not so much because it matures later but because it will hold on the tree for a longer time than most of the Lisa category. The Valencia is the important late orange, but it is of minor importance compared to the Lisas, which are the most important commercial citrus group. The Lisa oranges are usually harvested from November to January; the Mediterranean Sweet from February to March; and the Valencias from May to August. The length of the season depends on the blooms of the fruit and general cultural conditions.

In tests made at the Monterrey plant of Nesbitt de Mexico, S. A., the average values of Lisa oranges were found to be as follows (in degrees Brix): October 1949, 11.0; November 1949, 11.7; early December 1949, 12.4; late December 1949, 13.5; early January 1950, 13.5; late January 1950, 14.5.

It is estimated that at least 55 percent of the citrus acreage is planted to Lisas, about 20 percent to the Valencia, 15 percent to the Mediterranean Sweet, and the remaining 10 percent to Washington Navels, tangerines, grapefruit, and minor orange varieties.

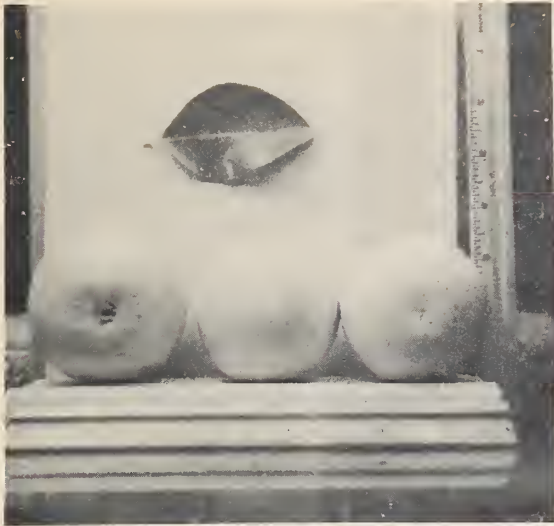
In order to obtain new data on the citrus grown in Nuevo Leon samples were obtained, examined, and photographed. The following photographs and descriptions may assist in evaluating the fruit quality in this district.



Washington Navel

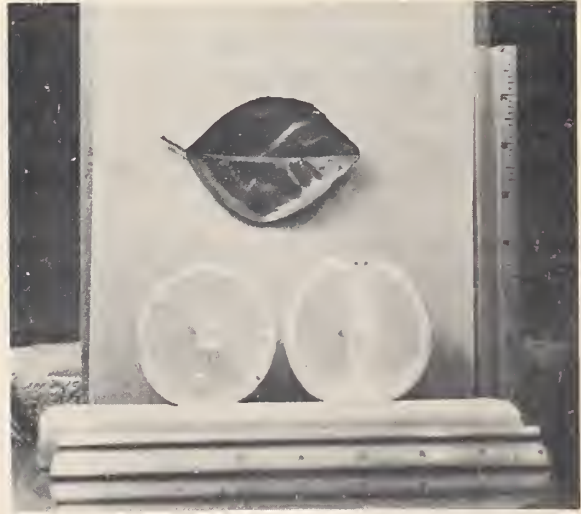
Washington Navel. This variety grows to large sizes in Nuevo Leon. In late November samples examined had a good flavor and contained 10 sections and no seeds.





San Miguel

San Miguel. This variety is also one of the Lisa group, and in late November the fruit was breaking in color. The fruits had a rather smooth peel and were almost round. Fruit examined had 12 sections and 10 to 11 seeds. The fruit was juicy and of good flavor. In Nuevo Leon this type has comparatively small fruit.



Pineapple

Pineapple. This variety is also one of the Lisa early group. It has a smooth peel, and in late November the fruit was yellow to breaking in color. The samples examined had 13 sections and 7 seeds. The fruit was juicy and of excellent flavor.



Parson Brown

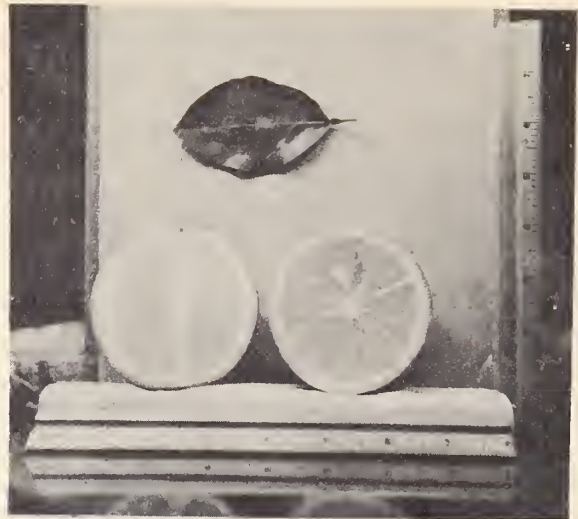
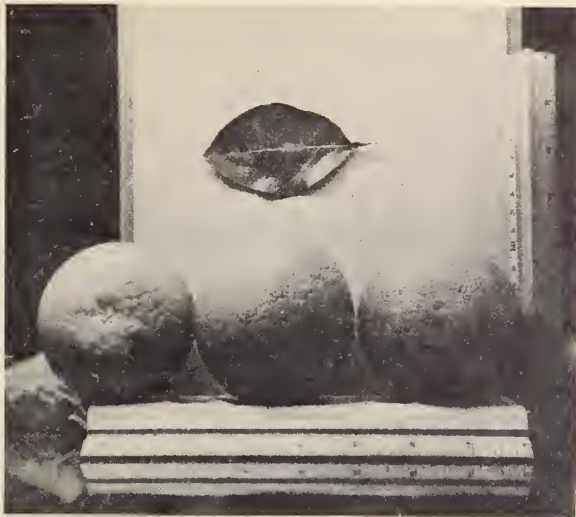
Parson Brown. This variety is one of the Lisa group. In late November fruits were yellow in color, and samples had 11 sections and 9 seeds. Fruit examined was full of juice, rather tart in flavor, and not as mature as the other Lisa types.



Mediterranean Sweet

Mediterranean Sweet. This variety is harvested as midseason fruit in Nuevo Leon. In late November the fruit was a smooth orange, yellow to breaking in color. The samples examined had 13 sections and 4 seeds. The fruits were juicy, had an excellent flavor, and were as mature as any of the Lisa group.





Valencia

Valencia. This is the late variety for Nuevo Leon. In late November fruits had a dark green peel, but the interior was well-colored. Samples examined had 10 sections and 2 seeds, and were juicy and tart.



Tangerine

Tangerine. In late November this variety was yellow. Samples examined had 10 sections and 8 seeds. The fruits were fairly sweet but had a rather tough fiber similar to the Florida tangerine.



A small export citrus packing plant at Linares.



Packinghouse for export oranges and grapefruit at Montemorelos.



Packing color-added oranges for export at Montemorelos.



Oranges in Bruce boxes for export to the United States (at Montemorelos).



## Marketing

Picking. Oranges in Nuevo Leon are pull-picked for both the domestic market and export. In orchards visited the pickers worked in teams. Pickers used ladders and pull-picked the fruit into baskets. When a picker's basket was full, he called an assistant, who served two or three pickers, and emptied the fruit into the assistant's basket. The fruit was then carried to a waiting oxcart in which it was transported to the edge of the orchard. There, the oxcart team was unhitched and the fruit dumped to the ground by tipping the cart. Pickers were being paid \$0.17 per 1,000 fruit. Since this was piece work, the picking was carried on very rapidly and the fruit received rough handling since it was dumped twice at the site of picking and once at the orchard edge. At the edge of the orchard the fruit is counted by the thousand. Fruit for the domestic market is placed in baskets as counted and then emptied into a truck for bulk transport to market. Fruit to be exported is counted and then placed in field boxes in which it is transported to a local packinghouse or to a packinghouse at the border.

Packing. Only fruit for export is packed. Within the past 5 years two packinghouses have been established at Linares, three at Montemorelos, and three at the border at Nuevo Laredo.

The packing process is rather complicated. First, the fruit is placed in an airtight room where it is gassed to break the color to an even yellow in order that the "color-add" will be evenly applied. If the fruit is to be exported to the United States, it is then taken to another airtight room where it is sterilized in accordance with U. S. Department of Agriculture regulations as a protection against larvae of the Mexican fruitfly. Under this process, the fruit is heated for a period of at least 10 hours. In the newer sterilization rooms a recording thermograph makes a permanent record of the temperatures reached in the interior of the fruit. After the fruit has been sterilized it is washed and waxed, and color is added. The fruit is then calibrated into standard sizes and naked-packed in single-compartment, Mexican-made Bruce boxes.

In 1951 wages at packinghouses were reasonable by comparison with United States standards. Men were reported to have been receiving \$0.69 to \$1.39 per day, and women packers were reported to have been receiving approximately \$0.03 per box.

Cost of packing and picking. The cost of picking and packing a box of oranges in 1950-51 is itemized in table 43. At that time the cost of the fruit to the packer was \$3.45 per thousand, which is reasonable in normal years. In the 1951-52 season, however, the crop was small and the cost of fruit was approximately 50 percent higher than that indicated for 1950-51. Packers stated that packing costs were also rising because of the increase in the price of boxes and in wage rates. It may be expected that in the 1951-52 season the average cost of packing will be about 25 percent higher than the cost indicated in table 43.

Table 43.--Oranges: Estimated cost of packed fruit from Linares at the border 1950-51

Item	Cost per box Dollars
Picking . . . . .	0.04
Transporting pickers to and from orchard . . . . .	0.01
Hauling fruit from grove to packinghouse . . . . .	0.04
Packing, washing, and coloring . . . . .	0.04
Packing and paper wraps . . . . .	0.14
Boxes, including cost of shook, and labor of fabrication	0.38
Box labels . . . . .	0.10
Wages, in plant on packing . . . . .	0.17
Electricity . . . . .	0.02
Total cash cost of picking and packing . . . . .	0.94
Depreciation of plant . . . . .	0.12
Gas sterilization treatment for fruit exported to United States . . . . .	0.12
Total cost of picking and packing . . . . .	1.17
Cost of fruit at 30 pesos per thousand . . . . .	0.72
Freight to Nuevo Laredo . . . . .	0.28
Total cost of packed fruit at border . . . . .	2.17

Source: Trade sources.

### Economic Factors

Value of land. As citrus plantings have been extended in the past 10 years, land values have increased. Trade sources indicate that in 1951 unplanted irrigated land was selling for about \$46.00 per acre and groves planted on irrigated land were selling for about \$117.00 per acre.

Wages. Wages in the orchard in 1951 varied from \$0.69 to \$1.04 per day, including the wages of tractor drivers. In the packinghouses, men were being paid about \$0.12 per hour, and women about \$0.09 per hour. In most well-maintained orchards the cultural labor load is about one man to every 10 acres where mechanical cultivation is used.

Returns to growers. In 1951 growers in Nuevo Leon stated that in a good irrigated grove growers expect to obtain a net return of about \$1.16 per tree in normal years. At this rate of return, orange growers receive a net return of \$70.25 per acre.



Cost of irrigation water. Growers in areas where gravity irrigation water can be obtained report that in 1951 the usual rate for water was \$0.46 per hour. In most groves the flow of water is sufficient to irrigate about 1 acre per hour. Thus, the cost of water for seven irrigations per year may be estimated at approximately \$3.25 per acre per year.

Taxes. Taxes are nominal; in 1951 growers stated that taxes averaged about \$0.23 to \$0.28 per acre per year.

Cost of production. The cost of operating a citrus grove varies greatly. Most groves receive less than optimum care, and some of the unirrigated groves receive very little care. The groves that are irrigated, cultivated, pruned, fertilized, and sprayed when necessary cost about \$0.69 per tree per year to operate. Since there are about 64 trees per acre on the average, the cost of operation is about \$42.15 per acre. Costs have increased considerably since 1948 when the estimated average cost of operation was \$15.00 per acre.

Yields of groves vary, but observations and trade estimates indicate that the average annual yield of a commercial grove is between 500 and 1,000 fruits per tree, which is equivalent to 30,300 to 60,600 per acre. Based on this range of yields and an operating cost of \$42.15 per acre, the cost of production is estimated as follows:

	<u>Low</u> <u>Dollars</u>	<u>High</u> <u>Dollars</u>
Cost of production:		
Per 1,000 fruits . . . . .	0.69	1.39
Per box of 250 fruits . . . . .	0.17	0.35

This range of cost of production is conservative, since the highest costs of best operation have been used with conservative yields. Some of the better groves will produce 2,000 oranges (8 boxes) per tree, and tangerines, which bear exceptionally heavy crops, may produce as much as 10 boxes per tree.

#### Break-even Cost at Border

Using the above cost of production and the cost of picking and packing as estimated at Linares (table 43), the break-even cost at the border for export fruit may be calculated as follows:

	<u>High</u> <u>Dollars</u> <u>per box</u>	<u>Low</u> <u>Dollars</u> <u>per box</u>
Cost of production . . . . .	0.35	0.17
Cost of picking and packing including sterilization . . . . .	1.17	1.17
Freight to Nuevo Laredo . . . . .	0.28	0.28
	<u>1.80</u>	<u>1.62</u>

These break-even costs, which do not include any profit to grower or packer, indicate that on the basis of production costs the Mexican citrus industry can be highly competitive in export markets. On the basis of these costs, a price of \$2.90 per box for fruit at the frontier will return a very satisfactory profit to both the grower and packer.

REQUIREMENTS FOR THE REGISTRATION OF PROCESSED CITRUS  
PRODUCTS TO BE IMPORTED INTO MEXICO 1/

Registration of all imported food products is required by Article 192 of the Sanitary Code of Mexico (Codigo Sanitario de los Estados Unidos Mexicanos), dated December 31, 1949, and published on January 25, 1950 in Diario Oficial, the official publication of the Mexican Government.

The following steps must be taken to register food products in Mexico:

1. The exporter must appoint a representative in Mexico.
2. A certificate must be obtained from local authorities or the Chamber or Commerce stating that the sale of the product is freely permitted in the country of origin. This certificate must be visaed by a Mexican Consul.
3. The representative must then present the letter appointing him as such, as well as the above-mentioned certificate, and three copies of the label of the product, to the Department for the Control of Foods and Beverages at the following address:

Departamento de Control de Alimentos y Bebidas  
Secretaria de Salubridad y Asistencia  
Paseo de la Reforma y Lieja  
Mexico, D. F.

and apply for the registration of the product.

The fee for the registration of each product is 50 pesos. 2/

The present policy is not to authorize the registration of bottled beverages. On the other hand, no difficulty is usually encountered in registering concentrates to be imported for the use of the domestic beverage industry.

1/ Mexican Ministry of Health, Department for the Control of Foods and Beverages. This information was obtained through the kindness of Mrs. Ana M. Gomez, American Embassy, Mexico, D. F.

2/ 8.64 pesos = \$1.00



# IMPORT AND EXPORT DUTIES

Table 44.--Mexico: Import duties on specified fresh citrus and citrus products

Item	Ad valorem duty				Specific duty		Total duty
	Value for duty	Ad			Pesos	Dollars	Dollars
	Pesos	Dollars	valorem	Dollars	Pesos	Dollars	Dollars
	per kg. 2/	per pound	rate (percent)	per pound	per kg. 1/	per pound	per pound
Lemons, fresh 2/	2.50	0.1312	30	0.0394	0.20	0.0105	0.0499
Oranges, fresh 2/	0.85	0.0446	60	0.0268	0.40	0.0210	0.0478
Fruit juices:							
With density not exceeding 1.25 at 15° C. (59° F.)	2.75	0.1443	30	0.0433	2.00	0.1050	0.1483
With density exceeding 1.25 at 15° C. (59° F.)	27.20	1.4276	55	0.7852	3.00	0.1575	0.9427
Fruit essences:							
Natural or synthetic . . .	55.00	2.8866	15	0.4330	5.00	0.2624	0.6954
Citric acid . . .	4.74	0.2488	20	0.0498	0.60	0.0315	0.0813

1/ A legal kilogram or gross kilogram includes the weight of the immediate container.

2/ Prohibited except with a permit from both the Ministry of Economy and the Ministry of Finance.

Source: Official sources.

Table 45.--Mexico: Export duties on specified fresh citrus and citrus products

Item	Value for duty		Duty		
	Pesos	Dollars	Pesos	Dollars	Additional
	per kg. 1/	per pound	per kg. 1/	per pound	ad valorem
					(percent)
Lemons and citron . . . . .	invoice value		none		3
Limes . . . . .	invoice value		none		3
Oranges and tangerines . . . . .	invoice value		none		3
Other citrus unspecified . . . . .	invoice value		none		3
Fruit juices . . . . .	invoice value		none		3
Essential oil, lime 2/ . . . . .	71.41	3.75	2/ 0.10	2/ 0.01	3
Essential oil, lime 3/ . . . . .	71.41	3.75	3/ 50.00	3/ 2.62	5
Citric acid . . . . .	6.89	0.36	none		17
Calcium citrate . . . . .	invoice value		none		17

1/ Gross, or legal, kilogram. Includes weight of immediate container.

2/ The Ministry of Agriculture determines exportable supplies and establishes an export quota each year and distributes this among the producers of essential oil of lime according to regulations. Under the quota this lower duty applies.

3/ Essential oil exported without a quota is subject to the higher duty.

Source: Official sources.

DEPARTMENT OF CHEMISTRY  
RESEARCH REPORT

The following table shows the results of the experiments conducted on the effect of temperature on the rate of reaction of the various substances. The data are given in the form of a table, the columns of which are headed by the names of the substances and the rows by the temperatures at which the experiments were conducted. The numbers in the cells of the table represent the rates of reaction, as determined by the method described in the text.

Substance	Temperature (°C)	Rate of Reaction
Sulfuric Acid	0	0.12
	25	0.25
	50	0.45
Nitric Acid	0	0.15
	25	0.30
	50	0.55
Hydrochloric Acid	0	0.10
	25	0.20
	50	0.40
Acetic Acid	0	0.08
	25	0.15
	50	0.30
Formic Acid	0	0.05
	25	0.10
	50	0.20

The results of the experiments show that the rate of reaction of the various substances increases with increasing temperature. The rate of reaction of sulfuric acid is the highest, followed by nitric acid, hydrochloric acid, acetic acid, and formic acid. The rate of reaction of formic acid is the lowest.

CHICAGO, ILL., 1925

THE UNIVERSITY OF CHICAGO  
DEPARTMENT OF CHEMISTRY

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